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ABSTRACT

Presented in this continuing plan for education are listings of competencies that students enrolled in the public elementary and secondary schools of Mississippi are expected to achieve by the time a particular grade level or subject area in the field of science is completed. Included are the needs assessment, goals and priorities, objectives, and procedure utilized in developing the Catalog of Science Competencies. (BT)

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THE MISSISSIPPI CATALOG OF COMPETENCIES FOR
PUBLIC ELEMENTARY AND SECONDARY
SCIENCE

Directed by

Office of Planning and Evaluation
State Department of Education
Post Office Box 771
Jackson, Mississippi 39205

September, 1974

Garvin H. Johnston, Ed.D., State Superintendent of Education

SE 029 822

**THE MISSISSIPPI CATALOG OF COMPETENCIES FOR
PUBLIC ELEMENTARY AND SECONDARY
SCIENCE**

**Directed by the Office of Planning and Evaluation
Mississippi State Department of Education**

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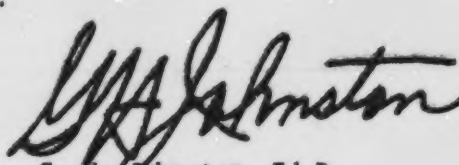
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FOREWORD

Identifying the specific expectations of pupils by the time a year of study in a selected subject field is completed is an important task in the development of a Continuing Plan for Education in Mississippi. This study is addressed specifically to the field of science and is designed to facilitate the achievement of the number one ranked goal which was for public elementary and secondary students to acquire cognitive achievement in the basic academic skills and/or the basic vocational-technical skills.

Sincere appreciation is expressed to all of the professional educators who willingly cooperated by responding to special requests for information concerning the development of a catalog of science competencies for public elementary and secondary education in Mississippi. Your response has made this project very much worthwhile.

A handwritten signature in dark ink, appearing to read "G. H. Johnston". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

G. H. Johnston, Ed.D.
State Superintendent of Education

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Chapter I

INTRODUCTION

The State Department of Education through the Office of Planning and Evaluation has undertaken a mammoth multiyear project that has strong implications for the improvement of the instructional programs in the elementary and secondary schools of Mississippi. The project is divided into five major phases which include assessing needs, setting goals and priorities based upon the identified needs, developing specifically stated objectives to accomplish the identified goals, evaluating the results based upon the developed objectives and recycling the procedure. The idea for the "Continuing Plan for Education in Mississippi" was conceived through the combined efforts of individuals representing each of the divisions and major programs within the State Department of Education. The implementation of the idea is now in the third phase.

Phase One: Needs Assessment

During 1972 educational needs for the public elementary and secondary schools of Mississippi were systematically identified. Evidence was accumulated to justify the identification of each need item. The major sources used to determine the statewide educational needs included the following:

- (1) an inventory was conducted among 3,990 individuals through a 276-item, seven-page questionnaire;
- (2) results from achievement tests were analyzed;
- (3) selective service information was utilized; and
- (4) statistical data compiled within the State Department of Education were synthesized.

Phase Two: Goals and Priorities

During 1973 a list of potential goal statements was developed for the public elementary and secondary schools of Mississippi by combining the previously identified need items into broad categories. School board members, superintendents, principals, teachers, students, parents, higher education personnel, legislators, business and industry managers, and educational organizational leaders were involved in the process of adopting and ranking the goal statements. Resulting from the study were thirty-four goals for the public elementary and secondary schools of Mississippi which were ranked in an order of priority. The goal ranked highest was for students "to acquire cognitive (intellectual) achievement in the basic academic skills (reading, mathematics, science, etc.) and/or the basic vocational-technical skills (woodworking, welding, drafting, etc.)."

Phase Three: Objectives

Phase three of the "Continuing Plan for Education in Mississippi" represents the development of specifically stated objectives designed to accomplish the adopted goals which resulted from phase two. Objectives, in this reference, are defined as precise descriptions of an educational goal which contain at least one component of each of six variables determined by answering each of the following questions: (1) of whom is the behavior or performance expected; (2) what behavior is desired or expected to occur; (3) to what activity will the behavior be related; (4) how will the change in behavior be specifically measured; (5) what period of time is needed to effect the expected change in behavior; and (6) to what proficiency level is the change in behavior expected.

One part of the third phase of the comprehensive plan for public elementary and secondary education in Mississippi is the development of a catalog

composed of competencies (precise expectations of students) for each of the grade levels and subject areas in the field of science for students taught in the public schools of Mississippi. Therefore, this study is the initial stage of phase three of the "Continuing Plan for Education in Mississippi."

Purpose

The purpose of this study was to develop a catalog containing listings of precise competencies that students enrolled in the public elementary and secondary schools of Mississippi are expected to achieve by the time a particular grade level or subject area in the field of science is completed.

Significance of Study

A disheartening observation is that many local districts attack the complex problem of curriculum development independently. One cannot help reflecting on the mammoth duplication of efforts involved. The project, to develop a catalog of competencies for the various disciplines of science which are taught in the public schools of Mississippi, offers a possible alternative to this duplication. Utilizing the resources of the professional science teachers in the public schools of Mississippi, the State Department of Education has attempted to provide each local district with a complete listing of competencies for each of the grade levels and subject areas taught in science. Therefore, the efforts and thoughts of thousands of teachers can be utilized in a type of synergistic convergence. This is not to suggest that any set of competencies should be viewed as the answer to an individual district's curricular problem but rather the efforts of others offer a convenient point of departure and may serve to stimulate diverse opinions about the direction of curricular thrust within the individual districts. The words of Sir Isaac Newton seem appropriate: "If I have seen further, it is by standing upon

the shoulder of giants." The compiled listings of competencies will be the combined efforts of numerous individuals and even then they may be but the shoulder on which others may stand.

The potential use of the final draft of a catalog of competencies in science is infinite. Included among the most obvious uses are the following: (1) teachers, students, parents, and other interested individuals can better know what achievement is expected by the time a particular grade level or subject area in science is completed; (2) in a classroom, in a school, in a district, or in the state the progress of students in the field of science can be evaluated on a more uniform basis; (3) a science catalog of competencies can aid in the development of curriculum guides, lesson plans, and measurement samples; (4) the science catalog can serve as a guide for a more extensive listing of competencies which are unique to a particular district, school, classroom, or individual; (5) the catalog of competencies can aid in the individualization of the science program; (6) when the expectations of students in a given field of study are known, the accountability concept can be more easily implemented; and (7) the science catalog of competencies can be utilized in the supervision of science programs.

Chapter II

PROCEDURE

The procedure for developing a catalog of competencies in the field of science has involved many individuals. A brief explanation of the procedures for this study is presented in the subsections below.

Involvement of Personnel from the State Department of Education

The schedules of all individuals within the State Department of Education who directly or indirectly had responsibilities with the science education program were coordinated to provide time for those individuals to conduct various functions which led to the development of the science catalog of competencies. The coordination process was conducted by the personnel from the Office of Planning and Evaluation.

Identification of Grade Levels and Subject Areas

To identify the specific grade levels and subject areas in the field of science for which competencies could be enumerated, the science supervisor from the State Department of Education utilized two major sources: (1) a computer printout which listed the names of the various courses offered in the public elementary and secondary schools of Mississippi, the number of schools offering those courses, and the total number of students enrolled in each course; and (2) a listing of approved science course offerings which appeared in the Mississippi "Standards for Accreditation of Elementary and Secondary Schools." Ultimately, eighteen grade levels and subject areas were selected for inclusion in the final catalog.

Initial Development of Proposed Science Competencies

To obtain an initial listing of proposed competencies for each of the grade levels and subject areas in the field of science, the science supervisors from the State Department of Education selected science teachers from the public schools of Mississippi to represent each level and subject area of science in a special work conference. A chairman for each committee of teachers was appointed by the state science supervisors. A letter (see appendix A) was mailed to each superintendent from whose district a teacher was selected. The purpose of the letter was to provide information about the proposed work conference. After notifying the superintendents, an invitation (see appendix B) was extended to each selected individual seeking the participation of that person in the proposed work conference. The number of persons agreeing to participate in the proposed work conference consisted of not less than three nor more than five individuals for each committee representing each grade level and subject area in the field of science.

Science work conference. An agenda was developed (see appendix C) for a two-day science work conference which was held at the Universities Center in Jackson, Mississippi, for the selected science teachers to begin identifying and organizing the proposed science competencies. After an opening general session with all participants, the science teachers were divided into their pre-determined committees. Each committee represented specific grade levels or subject areas in science and was charged with the responsibility of first developing a comprehensive topical outline which encompassed a year of study in that particular grade level or subject area. After the topical outline was developed, each group of science teachers was then charged with identifying and listing under the appropriate topic the competencies expected of students enrolled in that particular level or subject.

Activities immediately following the work conference. A two-day work conference proved to be too little time to develop a complete list of proposed competencies for each grade level and subject area in the field of science. Therefore, the participants of the work conference were given additional time following the conference to work individually to exhaust all resources available to them which would result in the completion of their assigned tasks. After that time, the chairman of each committee, respectively, collected the resulting competencies, organized them into a consistent form, and sent them to the State Department of Education.

Refinement of Proposed Competencies

After receiving from the chairmen of the various committees the lists of identified competencies, personnel within the State Department of Education proofread each list for organizational, grammatical, typographical, and content errors. Each of the eighteen lists was next typed, printed, and prepared for distribution to every public school in Mississippi where, hopefully, every public elementary and secondary science teacher was given the opportunity to react to the proposed competencies.

Distribution of Proposed Competencies

Before distributing the proposed competencies to the public elementary and secondary science teachers of Mississippi for their reactions, a letter (see appendix D) was mailed to all superintendents of local school districts. The purpose of the letter was to keep the superintendents fully informed about the progress of the project. Following the letter to all superintendents was another letter (see appendix E) mailed to the principals of all public elementary and secondary schools of Mississippi. Each principal received packets of competencies representing every grade level and subject area in science

offered in the school for which that person served as principal. Also, instructions to that principal for further distribution to the appropriate science teachers were included. A sample packet of materials for level one is included in appendix F. Similar packets were available for each of the other grade levels and subject areas of science. After a specified period of time, if the requested materials had not been returned to the State Department of Education, a second letter (see appendix G) was mailed to the principals who had been delinquent with the first request.

Reaction to Proposed Competencies

Science teachers were asked to react to the proposed competencies in three ways as follows: (1) indicate agreement or disagreement with each competency as a desirable expectation of the students you teach in the represented grade level or subject area (when more than one teacher teaches the same grade level or subject area in a given school, a consensus of opinions should be reflected); (2) suggest revision of stated terminology or content of the listed competencies; and (3) insert additional competencies that you feel should be included. After completing these tasks, the science teachers were instructed to return the completed materials to their respective principals, and the principals were requested to collect the materials and return them to the State Department of Education.

Response from Principals

As indicated in Table I a total of 4,648 separate lists of competencies representing each of the eighteen grade levels and subject areas in science were mailed to principals in whose schools those grade levels or subject areas were evidenced. A return of 3,813 or 82 percent was received by the State Department of Education.

TABLE I

NUMBER OF INSTRUMENTS MAILED AND RETURNED FOR DETERMINING
CONSENSUS OF AGREEMENT OR DISAGREEMENT FOR STATED
COMPETENCIES BY GRADE LEVEL OR SUBJECT AREA

Grade Level or Subject Area (1)	Number Mailed (2)	Number Returned (3)	Percent Returned (4)
Level One	524	426	81.3
Level Two	526	427	81.2
Level Three	524	428	81.7
Level Four	521	427	82.0
Level Five	509	415	81.5
Level Six	498	404	81.1
General Science (Level Seven)	126	101	80.2
Life Science (Level Seven)	113	94	83.2
General Science (Level Eight)	136	110	80.9
Earth and Space Science (Level Eight)	124	108	87.1
General Science (Level Nine)	206	175	85.0
Physical Science (Level Nine)	105	85	81.0
Biology	294	247	84.0
Marine Biology	3	2	66.7
Earth and Space Science (High School)	14	10	71.4
Advanced Physical Science	58	48	82.8
Chemistry	244	203	83.2
Physics	123	103	83.7
Total	4,648	3,813	82.0

Treatment of Returned Competencies

After organizing the returned packets of competencies into the grade levels and subject areas taught in science in the Mississippi elementary and secondary public schools, the packets of competencies were processed by the Data Processing Unit in the State Department of Education. A computer program was written which would yield for each competency in each grade level or subject area the number of responses agreeing with a proposed competency, the number of responses disagreeing with a proposed competency, the number of responses that neither agreed or disagreed with a proposed competency, and the total number of responses.

The appropriate response to each competency in each packet was then punched and verified on computer punch cards. The computer then produced a printout for each grade level or subject area of science with the appropriate totals for each competency. Each printout was analyzed to determine which competencies in a particular grade level or subject area were accepted as desirable competencies by the majority of respondents. A competency was determined to be acceptable if the number of respondents agreeing with the competency was greater than the number of respondents disagreeing with the competency. Those competencies which were determined to be unacceptable were removed from the final listing and included as additional competencies in the appendix by grade level or subject area (see appendix H). Other competencies submitted by the respondents were collected, organized, and catalogued by grade level and subject area (see appendix I).

Chapter III

RESULTING CATALOG OF SCIENCE COMPETENCIES

This chapter is divided into eighteen sections with each section containing the competencies expected of a student by the time a particular grade level or subject area in science is completed. Each of the competencies was approved by the majority of the science teachers in Mississippi who reacted to the survey. This compilation should be considered as the first edition of a catalog of competencies in science and should be constantly open to additions, deletions, and alterations.

The science competencies enumerated herein are the product of the science teachers in Mississippi and are not to be taken as a dictum from the state level to create a monolithic curriculum in the field of science. The purpose is to develop communication of expectations among teachers to allow for the development of cohesive science programs to meet the needs of students in science throughout Mississippi which will aid in the improvement of the instructional program.

Attention should be drawn to the fact that there was an overwhelming agreement with most of the items in each grade level and subject area expressed by the responding teachers. This response indicates the relevance of those items for the science programs in effect during the 1973-74 school year. However, programs change and the competencies expressed herein are also expected to change. Therefore, each teacher should be aware of the expectations of fellow professionals, yet free to choose those expectations which will best meet the needs of the students in a particular classroom.

ELEMENTARY SCIENCE

LEVEL 1

1.0 ANIMAL LIFE

1. 1 Fish
 - 1.1.1 Describe the life cycle of fish
 - 1.1.2 Describe the habitat of fish
 - 1.1.3 Give the biological requirements of fish
 - 1.1.4 Describe the physical aspects of fish
 - 1.1.5 Describe the care of young fish by the adult
1. 2 Frogs
 - 1.2.1 Describe the life cycle of the frog
 - 1.2.2 Give a physical description of the frog
 - 1.2.3 Tell how frogs move
 - 1.2.4 Describe the care of young frogs by the adult
 - 1.2.5 Name the food needs of frogs
1. 3 Mammals
 - 1.3.1 Describe the habitats of mammals
 - 1.3.2 Name some physical characteristics of mammals
 - 1.3.3 Tell how mammals care for their young
 - 1.3.4 Describe how the young look at birth
 - 1.3.5 Name the physical needs of mammals
1. 4 Birds
 - 1.4.1 Describe the habitat of the birds
 - 1.4.2 Tell how birds move about
 - 1.4.3 Describe the reproduction and care of young birds
 - 1.4.4 Describe the physical characteristics of birds
 - 1.4.5 Identify the physical needs of birds
1. 5 Compare and contrast--fish, frog, birds, and mammals

2.0 PLANT LIFE

2. 1 Name the three main parts of a plant
2. 2 Distinguish between the types of reproduction - seed, cuttings and bulbs, and spores
2. 3 Describe the life cycles of the seed plants
2. 4 Draw the plant parts
2. 5 Name the habitat needs for germination
2. 6 Record plant growth
2. 7 Name ways seeds travel
2. 8 Trees
 - 2.8.1 Know the two main types of trees
 - 2.8.2 Identify broadleaf trees
 - 2.8.3 Identify needletype trees
2. 9 Name the uses of plants
- 2.10 Describe how plants change by seasons

3.0 HUMAN BODY

3. 1 Measure how people grow
3. 2 Tell how the body parts function - eyes, ears, skin, nose, tongue
3. 3 Name foods necessary for good health
3. 4 Sort foods necessary for good health from a given display
3. 5 Explain how some drugs may be harmful and/or helpful to our bodies
3. 6 Draw symbols indicating harmful drugs

4.0 ATMOSPHERIC SCIENCE

4. 1 Clouds
 - 4.1.1 Tell the composition and origin of rainclouds
 - 4.1.2 Draw three types of clouds
4. 2 Name the four seasons
4. 3 Give the predominate weather for each season
4. 4 Tell or show at least two effects of rain
4. 5 Demonstrate that wind is moving air
4. 6 Give properties of air - color, shape, odor, taste, feel
4. 7 Uses of air
 - 4.7.1 Demonstrate use of air to plants
 - 4.7.2 Demonstrate use of air to animals
 - 4.7.3 Indicate the uses of air in recreation

5.0 GEOLOGY

5. 1 Indicate the shape of the earth
5. 2 Name parts of the earth
5. 3 Give three ways rocks are changed
5. 4 Demonstrate gravity
5. 5 Indicate up and down

6.0 ASTRONOMY

- 6.1 Stars
 - 6.1.1 Define a star
 - 6.1.2 Recognize the sun as a star
 - 6.1.3 Distinguish between sun's apparent and actual size in relation to other stars
 - 6.1.4 Draw the Big and Little Dippers
 - 6.1.5 Tell the differences between day and night stars
 - 6.1.6 Distinguish among North and South and East and West
- 6.2 Shadows
 - 6.2.1 Name the causes of shadows
 - 6.2.2 Tell how shadows change
- 6.3 Tell or demonstrate what causes day and night
- 6.4 Indicate directions using sun or stars

7.0 ECOLOGY AND CONSERVATION

- 7.1 Plant
 - 7.1.1 Discuss the role of forest fire prevention
 - 7.1.2 Discuss the care of helpful plants
- 7.2 Illustrate role of plants in soil conservation
- 7.3 Describe uses of dams and levees
- 7.4 Name contributors to air and water pollution
- 7.5 Apply methods of energy conservation
- 7.6 Tell why plants and animals need clean unpolluted air and water to stay alive and healthy
- 7.7 Point out and discuss the kinds and causes of pollution - air and water

8.0 CHEMISTRY

- 8.1 Identify, sort, and describe objects by their properties
- 8.2 Explain how water can change state but not composition

9.0 PHYSICS

- 9.1 Sound
 - 9.1.1 Distinguish between sounds made by different objects
 - 9.1.2 Demonstrate sound as vibration
 - 9.1.3 Distinguish between pitches
 - 9.1.4 Discuss noise pollution
- 9.2 Light
 - 9.2.1 Name at least three different sources of light
 - 9.2.2 Demonstrate that light is composed of many colors
 - 9.2.3 Explain the necessity of light to plants
- 9.3 Heat
 - 9.3.1 List four uses of heat
 - 9.3.2 Compile a list of four sources of heat
 - 9.3.3 Show how thermometer measures heat
 - 9.3.4 Describe objects in terms of hotter than or colder than the child's hand
- 9.4 Magnetism
 - 9.4.1 Demonstrate law of magnets
 - 9.4.2 Classify materials into magnetic and nonmagnetic
 - 9.4.3 List uses of magnets
 - 9.4.4 Induce magnetism into iron objects
 - 9.4.5 Show how magnetism passes through nonmagnetic materials
- 9.5 Name three simple machines
- 9.6 Identify simple machines by function

ELEMENTARY SCIENCE

LEVEL 2

1.0 ANIMAL LIFE

- 1.1 Insects
 - 1.1. 1 Describe an insect
 - 1.1. 2 Collect three insects
 - 1.1. 3 Draw the life cycle of a butterfly
 - 1.1. 4 Observe an ant colony noting three actions
- 1.2 Birds
 - 1.2. 1 Name materials needed for building a nest
 - 1.2. 2 Describe the development of a chick embryo
 - 1.2. 3 Observe how birds are adapted to living in their environment
- 1.3 Mammals
 - 1.3. 1 Tell about animals that must have parental care
 - 1.3. 2 Tell about animals that care for themselves
 - 1.3. 3 Name some animals found at the zoo
- 1.4 Amphibians
 - 1.4. 1 Know that amphibians spend part of their lives in water and part of it on land
 - 1.4. 2 Discuss the development of frogs or toads from the egg to the adult
 - 1.4. 3 Name three amphibians

2.0 PLANT LIFE

- 2.1 Growth of plants
 - 2.1. 1 Predict the effects of lack of water and/or light on plant growth
 - 2.1. 2 Name the three principle parts of a plant
 - 2.1. 3 Describe the function of each principle part of a plant
 - 2.1. 4 Describe a method of testing an idea (such as plants need water in order to grow)
 - 2.1. 5 State several ways in which plants may be grown without the use of seeds
 - 2.1. 6 Name one or more plants that are grown from some part other than a seed
- 2.2 Variety of plants
 - 2.2. 1 Indicate three ways seeds travel
 - 2.2. 2 Explain why living things are interdependent with one another and with their environment
 - 2.2. 3 List ways that plants serve as a food supply for man and animals
 - 2.2. 4 Identify and describe ways that animals are dependent upon plants for more than just food

3.0 HUMAN BODY

- 3.1 Living and non-living things
 - 3.1. 1 Distinguish the difference between living and non-living things
 - 3.1. 2 Observe how non-living things increase in size by an addition of materials
- 3.2 Cells
 - 3.2. 1 Identify the cell as a basic structural unit of all living things
 - 3.2. 2 Discuss the basic needs for cell growth
- 3.3 Factors affecting growth
 - 3.3. 1 Interpret the meaning of a balanced diet
 - 3.3. 2 Discuss the role of food and water for body energy and repair of cells
 - 3.3. 3 Classify plant or animals as food sources
- 3.4 Care of the body
 - 3.4. 1 List hygiene requirements for growth
 - 3.4. 2 Describe the role of the doctor, nurse, dentist, and pharmacist
 - 3.4. 3 Describe the causes and prevention of communicable diseases
 - 3.4. 4 Identify the symbol for poison
 - 3.4. 5 Indicate the importance of drugs being used only with permission from the doctor, parent or responsible adult
- 3.5 Safety - in growth and development
 - 3.5. 1 Discuss safety to and from school
 - 3.5. 2 Illustrate safety on the playground

4.0 EARTH SCIENCE

- 4.1 Atmospheric science
 - 4.1. 1 Locate cloud patterns in the sky
 - 4.1. 2 Describe the shapes of cloud patterns
 - 4.1. 3 Describe how clouds are formed
 - 4.1. 4 Describe how clouds move
 - 4.1. 5 Associate clouds with water condensation
 - 4.1. 6 Describe how fog and clouds are similar
 - 4.1. 7 Identify types of weather
 - 4.1. 8 Distinguish between snow and ice
 - 4.1. 9 Interpret and record temperature as a weather factor

4.2 Geology

- 4.2. 1 Describe the major features of the earth's surface
- 4.2. 2 Describe soil texture
- 4.2. 3 Describe some effects of wind and water on soil
- 4.2. 4 Describe the affects of plants and animals on the development of soil
- 4.2. 5 Identify different types of fossils
- 4.2. 6 Explain the value of earthworms

5.0 ASTRONOMY

5.1 Moon

- 5.1. 1 Discuss the physical characteristics of the moon size, shape of phases, motion
- 5.1. 2 Compare the relative sizes of the earth and the moon
- 5.1. 3 Identify some of the adaptations man must make when he leaves land and enters the hydrosphere
- 5.1. 4 Describe the motions of the (rotation-revolution) earth
- 5.1. 5 Describe the kind of clothing that would be needed on a trip to the moon
- 5.1. 6 Contrast the weight of an individual or object on the moon with their weight on Earth
- 5.1. 7 Tell why things fall down and not up
- 5.1. 8 Describe the temperature on the moon
- 5.1. 9 Compare the size, temperature, surface and gravitational attraction of the moon

5.2 Distinguish between natural and man-made satellites

5.3 Recognize the causes for day and night and seasons

5.4 The sun and other stars

- 5.4. 1 Tell why the sun is called a star
- 5.4. 2 Tell why some of the stars look small even though they are larger than the sun
- 5.4. 3 Tell why we can sometime see planets in the night sky
- 5.4. 4 Describe the composition of the sun
- 5.4. 5 Identify the sun as the basic source of energy

6.0 ECOLOGY

6.1 Air pollution

- 6.1. 1 Discuss the importance of air to living things
- 6.1. 2 Describe ways that the air becomes polluted
- 6.1. 3 Determine the harmful effects of air pollution on living things

6.2 Water pollution

- 6.2. 1 Show how man pollutes water
- 6.2. 2 Indicate problems caused by water pollution
- 6.2. 3 Identify water sources

6.3 Discuss some of the things that we can do to help control pollution of land, air, and water in the community

6.4 Conservation

- 6.4. 1 Name some natural resources
- 6.4. 2 State the causes of water shortages
- 6.4. 3 Tell ways to prevent forest fires
- 6.4. 4 Give reasons for concern about world resources
- 6.4. 5 Illustrate the symbol for Fire Prevention-Smokey

7.0 CHEMISTRY

7.1 Illustrate the three states of matter

7.2 Identify substances by using the five senses

7.3 Demonstrate how some substances will change states or properties

8.0 PHYSICS

8.1 Magnetism and electricity

- 8.1. 1 Identify magnetic and nonmagnetic materials
- 8.1. 2 Name things that magnets will attract
- 8.1. 3 Make a list of materials that contain iron from a collection of objects
- 8.1. 4 Predict what materials a magnetic force will penetrate
- 8.1. 5 Name several ways that man utilizes electricity
- 8.1. 6 Demonstrate the need for a switch in an electric circuit
- 8.1. 7 Show that electric circuits must be complete to produce a current
- 8.1. 8 Devise ways to show static electricity

8.2 Heat

- 8.2. 1 Identify sources of heat
- 8.2. 2 Demonstrate temperature measurement
- 8.2. 3 Identify heat as a form of energy
- 8.2. 4 Identify the sun as the basis of heat
- 8.2. 5 Compare the temperature of objects
- 8.2. 6 Identify the relationship of friction and heat from various observations
- 8.2. 7 Infer and test how changes in temperature affects different objects

8.3 Light

- 8.3. 1 Identify sources of light
- 8.3. 2 Show how light and heat are related
- 8.3. 3 Show how light and heat are necessary for life
- 8.3. 4 Demonstrate the bending of light
- 8.3. 5 Show how light is reflected
- 8.3. 6 Discuss the properties of light
- 8.3. 7 Show how light travels

8.4 Sound

- 8.4. 1 Demonstrate how sound is produced
- 8.4. 2 Distinguish between two sounds in terms of volume, duration and pitch
- 8.4. 3 Infer and test what will happen when a rubber band is plucked or stretched to various lengths
- 8.4. 4 Construct a simple telephone
- 8.4. 5 Construct simple musical instruments demonstrating sound
- 8.4. 6 Demonstrate loudness and pitch as a characteristic of sound

8.5 Simple machines

- 8.5. 1 Show through experimentation that in order to turn, a wheel needs an axle
- 8.5. 2 Identify by naming, some wheels that turn but do not roll from place to place
- 8.5. 3 Demonstrate how a simple machine can increase the ability to do heavy work
- 8.5. 4 Identify simple machines by function

ELEMENTARY SCIENCE

LEVEL 3

1.0 ANIMAL LIFE

- 1.1 Amphibians and reptiles
 - 1.1.1 Recognize and name one or more animals collected from a pond
 - 1.1.2 Describe the development of a frog from egg to adult
 - 1.1.3 Tell about the care of the young frog
 - 1.1.4 Generalize about the life cycle habitat of reptiles and amphibians
 - 1.1.5 Describe the physical attributes of amphibians and reptiles at each stage of development
- 1.2 Fishes
 - 1.2.1 Describe the physical attributes of fish
 - 1.2.2 Explain the gill structure
 - 1.2.3 Explain the gill function
 - 1.2.4 Draw the body covering
 - 1.2.5 Give reasons for changes in body temperature
 - 1.2.6 Give a description of the habitat of fishes
 - 1.2.7 Tell about care of the young fish
- 1.3 Birds
 - 1.3.1 Tell what determines type of food
 - 1.3.2 Describe the habitat variation and adaptation of birds
 - 1.3.3 Differentiate the types of feet
 - 1.3.4 Give the functions of the wings
 - 1.3.5 Explain variations in body covering and color
 - 1.3.6 Understand bird reproduction and care of young
 - 1.3.7 Differentiate between the physical attributes of birds and other animals
- 1.4 Mammals
 - 1.4.1 Differentiate mammals from other animals
 - 1.4.2 Describe body covering
 - 1.4.3 Explain care of young
 - 1.4.4 Know that most young born live
 - 1.4.5 Tell why a mammal is warm blooded
 - 1.4.6 Illustrate protective structure and coloration
 - 1.4.7 Tell different food needs and structural adaptations (how food is obtained)
 - 1.4.8 List methods of survival in cold weather
- 1.5 Insects
 - 1.5.1 Recognize insects by physical appearance
 - 1.5.2 Distinguish between insects and spiders and state criteria of evaluation
 - 1.5.3 Associate particular insects with their adaptations to their environment
 - 1.5.4 Describe different food needs of insects
 - 1.5.5 Describe reproductive process of insects

2.0 PLANT LIFE

- 2.1 Fungi
 - 2.1.1 Draw some fungi
 - 2.1.2 Explain food for fungi
 - 2.1.3 Give conditions for growth and reproduction of fungi
- 2.2 Green plants
 - 2.2.1 Name methods of reproduction
 - 2.2.2 Name and indicate function of seed parts
 - 2.2.3 Demonstrate growth from bulb
 - 2.2.4 Show growth from cutting
 - 2.2.5 Give environment for growth
 - 2.2.6 Identify and locate the major parts of plants
 - 2.2.7 Illustrate methods of seed dispersal
 - 2.2.8 Construct a diagram or model to show that a plant is a food factory
 - 2.2.9 Indicate food sources for plants
 - 2.2.10 Name uses of various green plants
 - 2.2.11 Describe how green leaves are alike
 - 2.2.12 Explain what happens when a green plant is deprived of sunlight
- 2.3 Woody plants
 - 2.3.1 Differentiate between the parts and functions of tree parts
 - 2.3.2 Name uses of various tree parts to man and animals
 - 2.3.3 Compare the two main methods of reproduction in trees
 - 2.3.4 Explain how the age of trees is determined
 - 2.3.5 Examine and contrast the uses of hard woods and softwoods

3.0 HUMAN BODY

- 3.1 Name the main structures of the body
- 3.2 Give the function of the circulatory system
- 3.3 Give the function of the bones
- 3.4 State why the body has bones of different shapes and sizes
- 3.5 Give the function of the muscles
- 3.6 Describe and demonstrate the relationship between activity and the rate of heartbeat
- 3.7 Illustrate how emotions show in body movements

- 3.8 Name the sense organs and tell how they help us
- 3.9 Describe the work of at least three body organs
- 3.10 Draw the three main components of the digestive system
- 3.11 Explain the breakdown of food in digestion
- 3.12 Name several reflexes that keep your body operating smoothly - sneezing, blinking, touching hot objects, etc.

4.0 DRUGS

- 4.1 Relate the effects of tobacco and alcohol, and other drugs on man's body
- 4.2 Describe good uses of drugs

5.0 EARTH SCIENCE

- 5.1 Atmospheric science
 - 5.1.1 Demonstrate use of weather map
 - 5.1.2 Identify and correlate weather factors i.e. wind, temperature, and precipitation with weather conditions
 - 5.1.3 Construct air thermometer
 - 5.1.4 Differentiate between Fahrenheit and centigrade
 - 5.1.5 Diagram the water cycle
 - 5.1.6 Perform controlled experiments with evaporation and condensation
- 5.2 Clouds in the sky
 - 5.2.1 Draw a cumulus cloud
 - 5.2.2 Draw a cirrus cloud
 - 5.2.3 Draw a stratus cloud
 - 5.2.4 Identify a thunderhead
 - 5.2.5 Describe the kind of weather brought by thunderheads
 - 5.2.6 Describe the formation of sleet
 - 5.2.7 Distinguish between the processes that form sleet and snow
 - 5.2.8 Describe the formation of hail
 - 5.2.9 Analyze the causes and effects of high and low pressure on the weather
 - 5.2.10 Explain the formation of tornadoes
 - 5.2.11 Describe the origin of hurricanes
 - 5.2.12 Compare and contrast the effects and predictability of hurricanes and tornadoes

6.0 ASTRONOMY

- 6.1 Space
 - 6.1.1 Explain the rotation of earth as to direction
 - 6.1.2 Generalize about the effect of earth's rotation and time zones in the U.S.
 - 6.1.3 Conduct experiments to explain sunrise and sunset
 - 6.1.4 Name five constellations
 - 6.1.5 Describe the North Star as a point of reference in the sky
 - 6.1.6 Describe the benefits of man's moon explorations to man in everyday life (vast medical, technical, scientific discoveries)
 - 6.1.7 Construct a sundial and keep a record of shadow lengths
 - 6.1.8 Identify various geometric shapes found in the constellations
 - 6.1.9 Describe the orbital path of planets around the sun

7.0 GEOLOGY

- 7.1 Conduct tests on rocks and classify by results
- 7.2 Draw the process and results of erosion - wind - water
- 7.3 List the three types of rock - igneous, sedimentary, metamorphic
- 7.4 Illustrate the layers of the earth - crust, mantle, core
- 7.5 Name kinds of rock formed by lava as it cools
- 7.6 Describe the relationship of water freezing to the weathering process of rocks
- 7.7 Name rocks that are changed by heat and pressure
- 7.8 Describe some natural events that alter the earth's crust

8.0 ECOLOGY AND CONSERVATION

- 8.1 Water
 - 8.1.1 Give three water sources
 - 8.1.2 Describe water treatment methods
 - 8.1.3 Hypothesize on the placement of dams, levees, reservoirs
 - 8.1.4 Diagram dams, levees
 - 8.1.5 Explain shortages of clean water
 - 8.1.6 Apply methods of water purification
- 8.2 Air
 - 8.2.1 List causes of air pollution
 - 8.2.2 Describe effects of air pollution
 - 8.2.3 Choose most feasible method of correction to apply in hypothetical situation of air pollution

8.3 Conservation

- 8.3.1 Know methods for saving energy in the home
- 8.3.2 Know methods for saving energy in the school

9.0 CHEMISTRY

- 9.1 Define matter
- 9.2 Name the properties of matter
- 9.3 Identify the changes in state of matter
- 9.4 Record differences/likenesses in various matters
- 9.5 Differentiate between mixtures and compounds
- 9.6 Demonstrate differences in behavior of solids, liquids, and gases

10.0 PHYSICS

10.1 Magnets

- 10.1.1 Identify different types of magnets
- 10.1.2 Illustrate the various sizes and strengths of magnets
- 10.1.3 Form hypothesis regarding strength of various parts of a magnet
- 10.1.4 Compare magnetic field of earth with that of a bar magnet
- 10.1.5 Explain how an electromagnet is made
- 10.1.6 List uses of electromagnets

10.2 Electricity

- 10.2.1 Illustrate a circuit
- 10.2.2 Describe production of electricity
- 10.2.3 Tell some sources of electric current
- 10.2.4 Tell how electric current makes things move, gives light, makes heat
- 10.2.5 Differentiate between conductive and nonconductive materials
- 10.2.6 Distinguish between static and kinetic electricity
- 10.2.7 List safety rules regarding use of electricity

10.3 Sound

- 10.3.1 Describe the movement of sound waves
- 10.3.2 Demonstrate that sound waves take time to travel

11.0 SCIENTIFIC METHOD

- 11.1 Explain the scientific method (hypothesis, record, experiment, etc.)
- 11.2 Demonstrate a knowledge of the scientific method through experiments

ELEMENTARY SCIENCE

LEVEL 4

1.0 BIOLOGICAL (LIFE SCIENCE)

1.1 Plants

- 1.1.1 Know that a seed must have a certain environment for germination
- 1.1.2 List three nutrients obtained from the soil
- 1.1.3 Name the sugar made by green plants
- 1.1.4 Know that a plant grows by cell division
- 1.1.5 Know that green plants are producers
- 1.1.6 Know that green plants use chlorophyll to make food
- 1.1.7 Know that stems provide support and transportation for nutrients and food products
- 1.1.8 Explain the functions of roots and root hairs
- 1.1.9 Describe the functions of stomata

1.2 Animals

- 1.2.1 Define animal cells
- 1.2.2 Explain the difference between a plant and animal cell
- 1.2.3 Name two ways one cell animals reproduce
- 1.2.4 Know that scientists classify animals into two large groups
- 1.2.5 Separate the animals into the two main groups
- 1.2.6 Describe ways in which animals may move from place to place
- 1.2.7 Identify animals which are predominantly carnivorous, herbivorous, or omnivorous

1.3 The human body

- 1.3.1 Name the major systems of the human body: circulatory, digestive, respiratory, nervous, skeletal, endocrine, excretory, and reproductive
- 1.3.2 Name three functions of the skeleton
- 1.3.3 Know that a group of cells form a tissue
- 1.3.4 Understand that a group of tissues make an organ
- 1.3.5 Know the function of ligaments and joints
- 1.3.6 Know that the bones cannot move without muscles
- 1.3.7 Name and describe the five senses
- 1.3.8 Match five kinds of tissues (blood, bone, epithelial, muscle and nerve) with their pictures
- 1.3.9 Know that the skin serves as a protective covering for the body

2.0 EARTH AND SPACE SCIENCE

2.1 Atmosphere and weather

- 2.1.1 Define atmosphere and weather
- 2.1.2 Know that wind, temperature, air pressure, and moisture affect weather conditions
- 2.1.3 Observe how water evaporation is related to the water cycle
- 2.1.4 Understand that the conditions of the earth's atmosphere are constantly changing
- 2.1.5 Know that air expands and contracts, exerts pressure, and can be compressed
- 2.1.6 Recognize that natural forces are continually changing the surface of the earth
- 2.1.7 Name several sources from which information can be gathered about the weather
- 2.1.8 List four ways man uses weather predictions to make decisions about his planned activities
- 2.1.9 List four instruments used to measure weather conditions
- 2.1.10 Understand that seasons are caused by the tilting of the earth's axis
- 2.1.11 Discover that the angle of the sun's rays is related to the amount of heat energy which an area receives
- 2.1.12 Understand that in the northern hemisphere the earth is closer to the sun during winter

2.2 The earth

- 2.2.1 Demonstrate how moving water changes the earth's surface
- 2.2.2 Describe how freezing water breaks down rocks
- 2.2.3 Know that the expansion and contraction of rocks and the force of growing plants help break down rock
- 2.2.4 Show how land worn down in one place is built up in another
- 2.2.5 Observe how plants reduce erosion
- 2.2.6 Know that pressures on and in the earth cause mountains to rise
- 2.2.7 Know that man's survival depends on the earth's resources

2.3 The universe

- 2.3.1 Understand that the earth rotates from west to east
- 2.3.2 Explain the difference between meteors, comets, and meteorites
- 2.3.3 Understand that rotation of the earth makes objects in space appear to move across the sky
- 2.3.4 Demonstrate the force of gravity and its effects on a body
- 2.3.5 Name the planets of the solar system
- 2.3.6 Know that other planets, in addition to earth, travel around the sun
- 2.3.7 Define constellations
- 2.3.8 Construct an inference about how the earth would be changed if the sun stopped shining
- 2.3.9 Demonstrate the earth's position and motion through space
- 2.3.10 Know that the earth's orbit is in the shape of an ellipse

5.0 PHYSICAL SCIENCE

- 3.1 Sound
 - 3.1.1 Understand that sound is a form of energy
 - 3.1.2 Show that sound is caused by vibrating objects
 - 3.1.3 Understand that the pitch of a sound depends on the rate of vibrations
 - 3.1.4 Define terms: vibration, pitch, echo, ultrasonic, frequency, and sound waves
 - 3.1.5 Construct a simple musical instrument
 - 3.1.6 Describe how sound travels
 - 3.1.7 Demonstrate that sound vibrations can be directed or deflected
 - 3.1.8 Understand that sound energy may be transmitted through solids, liquids, or gases
- 3.2 Light
 - 3.2.1 Demonstrate that light is the only form of energy which is visible
 - 3.2.2 Name two sources of light
 - 3.2.3 Describe how objects become visible as light is reflected from them to the eyes
 - 3.2.4 Demonstrate how light travels in waves
 - 3.2.5 Show that light may be transmitted through, reflected by, or absorbed by different materials
 - 3.2.6 Show that reflected light must reach the eye to be seen
 - 3.2.7 Describe how the lens of the eye collects light and projects it on the retina
 - 3.2.8 Name the major parts of the eye
 - 3.2.9 Describe how the lens of the eye work
 - 3.2.10 Recognize that most living things need light to live
 - 3.2.11 Know the difference between opaque and translucent
- 3.3 Matter
 - 3.3.1 Describe how matter is anything that occupies space
 - 3.3.2 Define molecules
 - 3.3.3 Recognize that different kinds of substances have different kinds of molecules
 - 3.3.4 Recognize that molecules are in constant motion
 - 3.3.5 Demonstrate that air has mass, occupies space, is elastic, exerts pressure, and is compressible
 - 3.3.6 Know that a substance may be recognized by its properties
 - 3.3.7 Define the term atom
 - 3.3.8 Understand that the atoms in an element are alike while the atoms in a compound are different
- 3.4 Electricity
 - 3.4.1 Know that atoms contain negatively charge particles called electrons and positively charged particles called protons
 - 3.4.2 Explain the two kinds of electricity
 - 3.4.3 Know that like electrical charges repel each other and unlike charges attract each other
 - 3.4.4 List three good conductors and three poor conductors of electricity
 - 3.4.5 Describe how a dry cell works
 - 3.4.6 Describe how an electromagnet works
 - 3.4.7 List four safety rules for using electricity

ELEMENTARY SCIENCE

LEVEL 5

1.0 BIOLOGICAL (LIFE SCIENCE)

1.1 Plants

- 1.1.1 Know that green plants manufacture food during the process of photosynthesis
- 1.1.2 Know that photosynthesis may take place in any plant part that contains chlorophyll
- 1.1.3 Name the sources where raw materials are obtained to carry on photosynthesis
- 1.1.4 Name the three parts of all higher plants
- 1.1.5 Describe the functions of the three parts of higher plants
- 1.1.6 Name and describe two kinds of leaves
- 1.1.7 Tell the difference between the two kinds of vein arrangement in leaves
- 1.1.8 Know that carbohydrates are produced during the process of photosynthesis
- 1.1.9 Write the word equation for photosynthesis
- 1.1.10 Name two types of plants that do not produce flowers or seeds
- 1.1.11 Explain why plants bend toward light
- 1.1.12 Name the parts of a seed
- 1.1.13 Relate how seeds are transported from place to place

1.2 Animals

- 1.2.1 Name the two large classifications of animals
- 1.2.2 Know that the simplest animals belong to the phylum protozoa
- 1.2.3 Know that every animal family has certain characteristic behavior patterns
- 1.2.4 Name ten members of the invertebrate group
- 1.2.5 Name the five main classes of vertebrates
- 1.2.6 Name two ways animals reproduce
- 1.2.7 Know that a single-celled organism performs all the life functions within the cell; a many-celled organism is a community of interdependent cells
- 1.2.8 Know that the pattern of the organism is passed along to new cells by duplication of chromosomes and their DNA content
- 1.2.9 Name the living material in a cell

1.3 The human body

- 1.3.1 Know that digestion begins as food is broken into smaller pieces
- 1.3.2 Know that groups of cells and tissues are organized into organ systems; all specialized to perform the body's functions
- 1.3.3 Know that the function of the respiratory system is to provide the body cells with oxygen
- 1.3.4 Explain how the circulatory system works with the digestive and respiratory system to supply the cell's needs
- 1.3.5 Know that the skeletal and muscular systems provide for body support and protection and enable it to move about
- 1.3.6 Know that the nervous system serves to coordinate the systems of the body
- 1.3.7 Describe how the excretory system enables the other systems to maintain a balance by removing wastes of oxidation
- 1.3.8 Name the main bones of the skeleton
- 1.3.9 Define the terms ligaments, tendons, and cartilage
- 1.3.10 Name the main organs of the digestive system
- 1.3.11 Name the four main chambers of the heart and their functions
- 1.3.12 Know that man is adapted for his environment

2.0 EARTH AND SPACE SCIENCE

2.1 The earth

- 2.1.1 Identify the three layers of the earth
- 2.1.2 Know that the earth's crust contains minerals, ores, rocks, and soil
- 2.1.3 Know that the topography of the crust has resulted from changes that have occurred on and within the earth
- 2.1.4 Understand that many of the resources of the earth are non-renewable
- 2.1.5 Know that the earth's crust is constantly changing
- 2.1.6 Define the terms earthquake and volcano
- 2.1.7 Describe how a seismograph records earthquakes
- 2.1.8 Distinguish between minerals, ores, and rocks
- 2.1.9 Name and describe the three classes of rocks
- 2.1.10 Know that topsoil, if properly used, is renewable and is one of man's most valuable resources
- 2.1.11 Know that the oceans cover about seventy percent of the earth's surface
- 2.1.12 Realize that the fossils of prehistoric forms of life yield evidence about the plants, animals and climate of the eras of the earth
- 2.1.13 Distinguish between weathering and erosion
- 2.1.14 Know that the heat pressure in the earth is caused by the breaking up of radioactive atoms which result in mountain building
- 2.1.15 Describe how conservation involves the use and management of resources in the proper manner

2.2 The universe

- 2.2.1 Know the three main theories about the formation of the universe
- 2.2.2 Demonstrate that the movements of all celestial bodies depend on gravitation and momentum
- 2.2.3 Name the four movements of the earth

- 2.2.4 Distinguish between luminous and nonluminous bodies
- 2.2.5 Discuss several problems in launching spacecrafts and putting men into space
- 2.2.6 Distinguish between mass and weight
- 2.2.7 Know the Law of Action and Reaction, the Law of Gravitation and the Law of Inertia
- 2.2.8 Draw an ellipse
- 2.3 Weather
 - 2.3.1 Interpret the basic data recorded on a weather map
 - 2.3.2 List the five layers of the atmosphere
 - 2.3.3 Explain the meaning of atmospheric pressure
 - 2.3.4 Name six instruments used by meteorologists
 - 2.3.5 Identify three main cloud formations
 - 2.3.6 Know how radar and weather conditions are used in tracking storms

3.0 PHYSICAL SCIENCE

- 3.1 Matter and energy
 - 3.1.1 Name three principle parts of an atom
 - 3.1.2 Know that elements are substances composed of only one kind of atom
 - 3.1.3 Define the terms molecule and compound
 - 3.1.4 Name the three states of matter
 - 3.1.5 Describe the properties of acids and bases
 - 3.1.6 Know the proper use of litmus paper in determining acids and bases
 - 3.1.7 Describe oxidation and give example of rapid and slow oxidation
 - 3.1.8 Know the difference between kinetic and potential energy
 - 3.1.9 Name and describe four kinds of energy: chemical, nuclear, heat and mechanical
- 3.2 Sound
 - 3.2.1 Know that sound is produced by vibrating bodies
 - 3.2.2 Know that sound waves travel through all forms of matter
 - 3.2.3 Explain the difference between frequency and amplitude
 - 3.2.4 Distinguish between the various types of musical instruments
 - 3.2.5 Identify the parts of the vocal anatomy
 - 3.2.6 Name the parts of the human ear and describe their functions
 - 3.2.7 List several materials that conduct sound and why they have this capability
- 3.3 Light
 - 3.3.1 Define the term spectrum
 - 3.3.2 Identify the two types of invisible light
 - 3.3.3 Differentiate between the wave and particle theory of light
 - 3.3.4 Understand the use of the spectroscope
 - 3.3.5 Describe how convex and concave lenses affect light
 - 3.3.6 Demonstrate the use of a prism to separate light (natural) into its components
 - 3.3.7 Define transparent, translucent, opaque, and reflective
- 3.4 Electricity
 - 3.4.1 Describe how a dry cell works
 - 3.4.2 Demonstrate how to connect a dry cell in the proper manner
 - 3.4.3 Describe an electromagnet
 - 3.4.4 Differentiate between static and current electricity

ELEMENTARY SCIENCE

LEVEL 6

1.0 BIOLOGICAL (LIFE SCIENCE)

1.1 Plants

- 1.1.1 Identify green plants as an organism
- 1.1.2 Recognize green plants as producers
- 1.1.3 Realize that green plants change sunlight energy into food energy
- 1.1.4 Describe photosynthesis as the food-making process in green plants
- 1.1.5 Recognize that all living things get food from green plants or from animals that eat green plants
- 1.1.6 List the four main parts of the flowering plant in order of development and describe their functions
- 1.1.7 Identify four parts of a seed from observation
- 1.1.8 Identify the reproductive parts of a plant and the role each part plays
- 1.1.9 Distinguish among pollination, fertilization, and germination
- 1.1.10 Describe conditions necessary for germination of seeds
- 1.1.11 Name four ways pollination can take place
- 1.1.12 Demonstrate how fertilization takes place in flowering plants
- 1.1.13 Recognize interdependence among the plants and animals in an environment

1.2 Animals

- 1.2.1 Identify animals as organisms and consumers
- 1.2.2 Identify the different kinds of organisms in a familiar environment (plant-eating, predators-prey, parasite-host) and their contribution to an environment
- 1.2.3 Describe a food chain
- 1.2.4 Describe interdependence among the animals and other organisms in an environment
- 1.2.5 Distinguish among habitat, environment, community, and ecosystem
- 1.2.6 Construct an ecosystem chart describing interaction between the biotic community and its physical environment
- 1.2.7 Distinguish among producers, consumers, and decomposers
- 1.2.8 Recognize that animals are adapted for living in different environments

1.3 The cell

- 1.3.1 Recognize that a single-celled organism begins life as a single cell
- 1.3.2 Know that a many-celled organism begins life as a single fertilized egg
- 1.3.3 Recognize that cells are produced only by other cells
- 1.3.4 Know that cells are the smallest living unit of matter
- 1.3.5 Identify mitosis
- 1.3.6 Describe the results of one cell dividing
- 1.3.7 Name the three substances necessary for cell growth and reproduction
- 1.3.8 Name and describe the major parts of a plant and animal cell
- 1.3.9 Know how tissues, organs and systems are formed from like cells
- 1.3.10 Recognize that the cells, tissues, organs, and systems are interdependent

1.4 The human body

- 1.4.1 Recognize man as an organism and a consumer
- 1.4.2 Describe the life cycle of man
- 1.4.3 Know that man is a many-celled organism that begins life as a single fertilized egg cell
- 1.4.4 Name and relate the functions of the systems of the human body
- 1.4.5 List three major divisions of the skeletal system
- 1.4.6 Name two major functions of the skeleton
- 1.4.7 Know that movements of the skeleton are caused by contraction and relaxation of muscles
- 1.4.8 Describe three general types of muscles
- 1.4.9 Recognize that the nervous system is a network of nerve cells branching out to cells in all parts of the body
- 1.4.10 Know that man learns from stimuli received, transmitted, and interpreted by his five senses and the entire nervous system
- 1.4.11 Know that impulses travel through the nervous system
- 1.4.12 Recognize that the body can be kept in good working order through good hygienic practices
- 1.4.13 Know about harmful and useful drugs and how they affect the body

2.0 EARTH AND SPACE

2.1 Hydrosphere

- 2.1.1 Know that ocean water is a mixture of liquid, solids, and gases
- 2.1.2 Define the term oceanographer
- 2.1.3 Know that there are differences in light, temperature, and pressure in the ocean
- 2.1.4 Tell the difference between distilled water and ocean water
- 2.1.5 Distinguish among surface zone, thermocline and zone of uniform temperature
- 2.1.6 List the main factors that cause ocean currents

2.2 Atmosphere

- 2.2.1 Name and describe the characteristics of the four layers of the atmosphere
- 2.2.2 Describe the effects of sunlight on the atmosphere
- 2.2.3 Identify the principle components of air
- 2.2.4 Describe the water cycle
- 2.2.5 Describe conditions that cause air currents
- 2.2.6 Define the term meteorologist

- 2.2.7 Identify three of the major air masses
- 2.2.8 Describe the composition of a cloud
- 2.2.9 Identify three types of clouds
- 2.2.10 Distinguish between a cold and warm front
- 2.2.11 Recognize that the primary cause of air current is temperature variation
- 2.2.12 Distinguish among cyclone, hurricane, typhoons, and tornado
- 2.2.13 Know that our weather occurs in the troposphere
- 2.3 Universe
 - 2.3.1 Construct a drawing of the solar system
 - 2.3.2 Recognize that the universe is in constant change
 - 2.3.3 Distinguish between a reflecting and a refracting telescope
 - 2.3.4 Distinguish among image, eyepiece, and object glass
 - 2.3.5 Know the use of a spectroscope
 - 2.3.6 Know the difference in temperature and color in comparison of our sun with other stars
 - 2.3.7 Name the two most abundant gases in the sun
 - 2.3.8 Demonstrate the location of zenith, horizon, and the North Star and tell the importance of Polaris to early navigation
 - 2.3.9 Define a light year
 - 2.3.10 Identify the term astronomer

3.0 PHYSICAL SCIENCE

- 3.1 Matter and energy
 - 3.1.1 Observe, describe, and measure the properties of samples of matter
 - 3.1.2 Describe the relationship between atoms and molecules
 - 3.1.3 Distinguish among an element, compound, mixture and solution
 - 3.1.4 Classify symbols as elements or compounds
 - 3.1.5 Name the parts of an atom
 - 3.1.6 List some special properties of matter, such as shape, color, odor, brittleness, elasticity, and conductivity
 - 3.1.7 Identify and describe general properties of matter (inertia, mass weight, volume, density, and porosity)
 - 3.1.8 Demonstrate the process of diffusion
 - 3.1.9 Recognize that normally energy cannot be created or destroyed
 - 3.1.10 Know that sunlight is the basic source of all energy
 - 3.1.11 Distinguish between potential and kinetic energy
 - 3.1.12 Recognize heat as kinetic energy of molecules
 - 3.1.13 Demonstrate changes in the state of matter
 - 3.1.14 Distinguish among physical, chemical, and nuclear changes
 - 3.1.15 Describe five kinds of energy
- 3.2 Light, heat, and sound
 - 3.2.1 Describe the two sources of light
 - 3.2.2 State the speed of light
 - 3.2.3 Recognize that an object heated to incandescence gives off light
 - 3.2.4 Define two main characteristics of light
 - 3.2.5 Define the term photon
 - 3.2.6 Define and describe translucent, opaque and transparent
 - 3.2.7 List the properties of light
 - 3.2.8 Know that light changes direction when going from one medium to another
 - 3.2.9 Arrange light in the six spectrum colors according to frequencies (high to low)
 - 3.2.10 Describe how convex and concave lenses affect light
 - 3.2.11 Distinguish among conduction, convection, and radiation as methods of heat transfer
 - 3.2.12 Recognize the importance of insulation in heat control
 - 3.2.13 State the speed of sound
 - 3.2.14 Recognize that the properties of matter determine the speed at which sound travels
- 3.3 Magnetism and electricity
 - 3.3.1 Know that the earth acts as a huge magnet
 - 3.3.2 Recognize that there are natural and manufactured magnets
 - 3.3.3 Demonstrate that the flow of electrons can produce the effect of magnetism
 - 3.3.4 List different classes of materials a magnet will attract
 - 3.3.5 Demonstrate three ways electricity can be generated
- 3.4 Machines
 - 3.4.1 Know that most large complex machines are modifications or combinations of a few simple machines
 - 3.4.2 Identify several simple machines and describe how each one can be used
 - 3.4.3 Recognize that machines can multiply force, increase speed, or change direction

GENERAL SCIENCE

LEVEL 7

1.0 THE NATURE OF LIFE

- 1.1 Living things
 - 1.1.1 Distinguish between the living and nonliving things
 - 1.1.2 Name four characteristics of living things
 - 1.1.3 Name the physical requirements for life
- 1.2 Cellular organization
 - 1.2.1 Demonstrate use and care of the microscope
 - 1.2.2 Identify three major parts of the cell
- 1.3 Energy and life processes
 - 1.3.1 Describe how energy is obtained from matter
 - 1.3.2 Describe how energy from food is used by the body

2.0 THE DIVERSITY OF LIFE

- 2.1 Protista
 - 2.1.1 Recognize contributions of early investigators of microorganisms
 - 2.1.2 Define the characteristics of the group of organisms known as the protist
- 2.2 Plants
 - 2.2.1 Plants without chlorophyll
 - 2.2.1.1 Describe the importance of plants without chlorophyll to other living organisms, including man
 - 2.2.1.2 Recognize the harmful effects of plants without chlorophyll on man
 - 2.2.2 Simple green plants
 - 2.2.2.1 Explain the role of simple green plants in the food chain
 - 2.2.2.2 Describe the purpose of chlorophyll in green plants
 - 2.2.3 Vascular green plants
 - 2.2.3.1 Spore bearing plants
 - 2.2.3.1.1 Describe spore bearing plants
 - 2.2.3.1.2 Relate the economic importance of prehistoric ferns to present energy needs
 - 2.2.3.2 Nonwoody seed plants
 - 2.2.3.2.1 Describe nonwoody seed plants
 - 2.2.3.2.2 List raw materials and products of photosynthesis
 - 2.2.3.3 Woody seed plants
 - 2.2.3.3.1 Distinguish among vines, shrubs, and trees
 - 2.2.3.3.2 Identify oaks, pines, magnolias, sweetgum, beech, sycamore
- 2.3 Animals
 - 2.3.1 Lower invertebrates
 - 2.3.1.1 Distinguish between vertebrates and invertebrates
 - 2.3.1.2 Name two vertebrates and two invertebrates
 - 2.3.2 Higher invertebrates
 - 2.3.2.1 Name one major characteristic of mollusks, annelids, arthropods, and echinoderms
 - 2.3.2.2 Label the three body parts of an insect
 - 2.3.2.3 Name four ways in which insects are harmful and four ways in which insects are beneficial to man
 - 2.3.3 Vertebrates
 - 2.3.3.1 General structure of vertebrates
 - 2.3.3.1.1 List five general characteristics of all vertebrates
 - 2.3.3.1.2 Name the five major classes of vertebrates
 - 2.3.3.2 Fish
 - 2.3.3.2.1 Name the two main classes of fish
 - 2.3.3.2.2 Name one fish from each of the two main classes of fish
 - 2.3.3.3 Amphibians
 - 2.3.3.3.1 Define the term amphibian
 - 2.3.3.3.2 Describe why frogs and toads belong to the class amphibians
 - 2.3.3.4 Reptiles
 - 2.3.3.4.1 List three general characteristics of reptiles
 - 2.3.3.4.2 Name the common members of the reptile group
 - 2.3.3.5 Birds
 - 2.3.3.5.1 Explain how a bird is adapted for flight
 - 2.3.3.5.2 Give two reasons why birds are important to man
 - 2.3.3.6 Mammals
 - 2.3.3.6.1 General characteristics of mammals
 - 2.3.3.6.1.1 Name five characteristics common to all mammals
 - 2.3.3.6.1.2 List the main orders belonging to the class of mammals
 - 2.3.3.6.2 Structures and their functions in man
 - 2.3.3.6.2.1 Respiratory system
 - 2.3.3.6.2.1.1 Describe the function of the respiratory system
 - 2.3.3.6.2.1.2 Name the organs of the respiratory system

- 2.3.3.6.2.2 Digestive system
 - 2.3.3.6.2.2.1 Name the parts of the digestive system and give the function of each organ
 - 2.3.3.6.2.2.2 Give the three uses of food in the body
- 2.3.3.6.2.3 Circulatory system
 - 2.3.3.6.2.3.1 Describe the function of the circulatory system
 - 2.3.3.6.2.3.2 Identify the auricles and the ventricles
 - 2.3.3.6.2.3.3 Give the purpose of the arteries, veins, and capillaries
- 2.3.3.6.2.4 Urinary-excretory system
 - 2.3.3.6.2.4.1 Describe the function of the urinary-excretory system
 - 2.3.3.6.2.4.2 Name the main structures of the urinary-excretory system
- 2.3.3.6.2.5 Muscular system
 - 2.3.3.6.2.5.1 Describe the function of the muscular system
 - 2.3.3.6.2.5.2 Differentiate between voluntary and involuntary muscles and give an example of each
- 2.3.3.6.2.6 Reproductive system
 - 2.3.3.6.2.6.1 Distinguish between sexual and asexual reproduction
 - 2.3.3.6.2.6.2 Define the terms: egg, sperm, fertilization, genes, chromosomes, heredity, dominant characteristics, and recessive characteristics
- 2.3.3.6.2.7 Growth and control of the body
 - 2.3.3.6.2.7.1 Describe the two important changes that take place in the body during adolescence
 - 2.3.3.6.2.7.2 Describe the body systems that contribute to the growth stages
- 2.3.3.6.2.8 Health and the care of the body
 - 2.3.3.6.2.8.1 Describe the effects of the following drugs on the body: alcohol, nicotine, marijuana, LSD, and heroin
 - 2.3.3.6.2.8.2 List ten principle health care practices that people should observe to maintain good health

3.0 THE RELATIONSHIP OF LIFE

- 3.1 Describe an ecosystem
- 3.2 Diagram a three-link food chain
- 3.3 Contrast predator-prey relationships
- 3.4 Identify producers and consumers

4.0 THE EARTH

4.1 Lithosphere

- 4.1.1 Crust
 - 4.1.1.1 Locate the boundaries of the earth's crust on a model
 - 4.1.1.2 Explain the formation of mountains by volcanism
 - 4.1.1.3 Explain the formation of mountains by crustal movement
 - 4.1.1.4 Describe the composition of soil
 - 4.1.1.5 Describe how erosion is changing the earth's crust
 - 4.1.1.6 List three sites where sand erosion occurs
 - 4.1.1.7 List three places that experiences wind erosion
 - 4.1.1.8 Describe why earthquakes often occur along faults
 - 4.1.1.9 Describe the formation of underground caves
 - 4.1.1.10 Explain how stalactites are formed
 - 4.1.1.11 Explain how stalagmites are formed
- 4.1.2 Rocks
 - 4.1.2.1 Explain how igneous rocks are formed
 - 4.1.2.2 List five examples of igneous rocks
 - 4.1.2.3 Describe how sedimentary rock is formed
 - 4.1.2.4 Explain why most fossils are found in sedimentary rock

- 4.1.2.5 Explain the four processes by which metamorphic rocks are formed
- 4.1.2.6 Relate the importance of fossil fuels to the economy of our country
- 4.1.3 Minerals
 - 4.1.3.1 Distinguish between rocks and minerals
 - 4.1.3.2 Describe four physical properties used to identify many minerals
 - 4.1.3.3 List five minerals occurring naturally in Mississippi
- 4.1.4 Mantle
 - 4.1.4.1 Describe the boundaries of the earth's mantle
 - 4.1.4.2 Describe the probable composition of the earth's mantle
- 4.1.5 Outer core
 - 4.1.5.1 Define the boundaries of the outer core
 - 4.1.5.2 Describe the probable composition of the outer core
- 4.1.6 Inner core
 - 4.1.6.1 Define the boundaries of the inner core
 - 4.1.6.2 Describe the probable composition of the inner core
- 4.2 Hydrosphere
 - 4.2.1 Oceans
 - 4.2.1.1 State the percentage of the earth covered by oceans
 - 4.2.1.2 Know the economic importance of the ocean to man
 - 4.2.1.3 Describe the direction of movement of ocean currents
 - 4.2.1.4 Demonstrate the circulation of water due to temperature changes
 - 4.2.2 Rivers
 - 4.2.2.1 Compare the size, composition, and flow of five principle rivers
 - 4.2.2.2 Relate the importance of rivers to man's livelihood
- 4.3 Atmosphere
 - 4.3.1 Troposphere
 - 4.3.1.1 Identify the boundaries in kilometers of the troposphere
 - 4.3.1.2 Describe the properties of the troposphere
 - 4.3.1.3 Relate the composition of air to the composition of a pure gas
 - 4.3.1.4 Describe four types of clouds
 - 4.3.1.5 Name three types of frontal systems
 - 4.3.1.6 Describe the kind of weather which usually accompanies each type of front
 - 4.3.1.7 Describe the causes of: rain, sleet, snow, and hail
 - 4.3.1.8 Explain the functions and uses of: thermometer, barometer, hygrometer, wind vane, and anemometer
 - 4.3.1.9 Explain what is meant by the term climate
 - 4.3.1.10 Name the six major climates of the world
 - 4.3.1.11 Name one location where each major climate occurs
 - 4.3.2 Other strata of the atmosphere
 - 4.3.2.1 Define the boundaries in kilometers of: stratosphere, chemosphere, ionosphere, and exosphere
 - 4.3.2.2 Name the chief characteristic of the: stratosphere, chemosphere, ionosphere, and exosphere

5.0 THE SOLAR SYSTEM

- 5.1 Theories of origin and arrangement
 - 5.1.1 Explain four theories relating the origin of our solar system
 - 5.1.2 State the principle argument of each theory regarding the origin of our solar system
 - 5.1.3 Construct a representative model of our solar system
- 5.2 Planets
 - 5.2.1 Name the planets of our solar system
 - 5.2.2 Describe three general characteristics of each planet
- 5.3 The moon
 - 5.3.1 Compare the size of the moon to that of the earth
 - 5.3.2 State the distance from the moon to the earth
 - 5.3.3 Describe the physical features of the moon
 - 5.3.4 Explain the rotation and revolution of the moon
 - 5.3.5 Name the phases of the moon
 - 5.3.6 Illustrate an eclipse of the moon
- 5.4 Earth
 - 5.4.1 Explain the causes of day and night
 - 5.4.2 Explain the causes of the seasons
 - 5.4.3 Describe one year in terms of the earth's movements
 - 5.4.4 Explain the necessity for time belts
 - 5.4.5 Define the terms latitude and longitude
 - 5.4.6 Distinguish between sidereal time and solar time
- 5.5 The sun
 - 5.5.1 State the distance from the earth to the sun
 - 5.5.2 Compare the size of the sun to the size of the earth
 - 5.5.3 Name the layers of the sun
 - 5.5.4 Name the two principle elements found composing the sun
 - 5.5.5 Explain the causes of sunspots
 - 5.5.6 Relate solar flares to the aurora borealis
 - 5.5.7 Explain the relationship between solar flares and the Van Allen radiation belt

6.0 STARS

- 6.1 Explain why light years are used to measure the distance between stars
- 6.2 Interrelate color, age and temperature of a star
- 6.3 Map six of the most common constellations
- 6.4 Define the term galaxy
- 6.5 Diagram the four shapes of galaxies
- 6.6 Locate our solar system in the Milky Way Galaxy
- 6.7 Define the term nebulae

7.0 SPACE EXPLORATION

- 7.1 Describe the accomplishments of men such as: Goddard, Von Braun, Sheppard, Glenn, and Armstrong
- 7.2 Relate the primary purposes and accomplishments of the following space programs: Explorer, Vanguard, Discoverer, Pioneer, Mercury, Ranger, Surveyor, Gemini, Mariner, Appollo, and Skylab

8.0 MATTER

- 8.1 Measurement of matters
 - 8.1.1 Name the units of length, volume, and mass-weight in the metric system
 - 8.1.2 Interpret the prefixes used in the metric system
 - 8.1.3 Know the boiling and freezing points of water using the centigrade scale
 - 8.1.4 Know the normal body temperature of man on the centigrade scale
 - 8.1.5 Demonstrate the use of metric units for making determinations for length, mass-weight and volume
- 8.2 Forms of matter
 - 8.2.1 Identify the three states of matter
 - 8.2.2 Describe the relationship of heat energy to water as it may appear in different states
 - 8.2.3 Explain the differences in physical properties exhibited by the three states of matter
- 8.3 Composition of matter
 - 8.3.1 Identify the terms atom, molecule, isotope, proton, neutron, and electron
 - 8.3.2 Describe the relationships among electrons, neutrons, protons, atoms, molecules and isotopes as to composition
 - 8.3.3 Demonstrate how the properties significant in determining if a substance is an element, a compound, or a mixture may be utilized
- 8.4 Changes in matter
 - 8.4.1 Describe a physical change
 - 8.4.2 Demonstrate four physical changes
 - 8.4.3 Describe a chemical change
 - 8.4.4 Identify five common chemical changes
 - 8.4.5 Relate energy to physical changes
 - 8.4.6 Associate energy to chemical changes
- 8.5 Motion of matter
 - 8.5.1 Define the term work
 - 8.5.2 Relate force to motion and acceleration
 - 8.5.3 Describe friction
- 8.6 Machines
 - 8.6.1 Name five simple machines
 - 8.6.2 Demonstrate how the mechanical advantage of a machine can be determined
 - 8.6.3 Illustrate the use of simple machines to: multiple force, change direction of an applied force, or increase the speed of accomplishing a task
 - 8.6.4 Relate power to work and time
 - 8.6.5 Determine the efficiency of laboratory models of two simple machines

9.0 ENERGY

- 9.1 Heat
 - 9.1.1 Define the term heat energy
 - 9.1.2 Describe four ways heat may be produced
 - 9.1.3 Describe how heat is measured
 - 9.1.4 Distinguish between calories and temperature
 - 9.1.5 Explain how heat is transferred
- 9.2 Sound
 - 9.2.1 Describe how sounds are produced
 - 9.2.2 Define the terms: sound wave, pitch, echo, amplitude, wavelength, frequency, and music
 - 9.2.3 Know the speed of sounds in air
 - 9.2.4 Describe how sounds are produced by the larynx
 - 9.2.5 Interpret a series of notes when sounded as being music or noise
- 9.3 Light
 - 9.3.1 Describe four light sources
 - 9.3.2 Explain the properties of light

- 9.3.3 Describe the experiment by Michelson to measure the speed of light
- 9.3.4 Define intensity, standard candle, illumination, and foot-candle
- 9.3.5 Understand the application of the inverse-square law as it relates to illumination
- 9.3.6 Demonstrate the processes of reflection and refraction, using common materials
- 9.3.7 Demonstrate the dispersing of light using a prism
- 9.4 Electricity and magnetism
 - 9.4.1 Illustrate the magnetic field about a bar magnet
 - 9.4.2 Demonstrate the law of magnets
 - 9.4.3 Explain how to make an electromagnet
 - 9.4.4 Describe five uses of magnets
 - 9.4.5 Demonstrate the production of static electricity
 - 9.4.6 Describe two ways of producing current electricity
 - 9.4.7 Construct a simple electric motor
 - 9.4.8 Describe the measurement units for electricity
 - 9.4.9 Relate the current, resistance and potential of a circuit
 - 9.4.10 Know the rules for safety as related to electricity
 - 9.4.11 Relate current, voltage and power to an appliance's electrical needs for proper functioning

LIFE SCIENCE

LEVEL 7

1.0 SCIENCE AND HUMAN ACTIVITY

- 1.1 The influence of science on human life
 - 1.1.1 Living conditions
 - 1.1.1.1 State the need for scientific inventions
 - 1.1.1.2 Identify six methods of communication as a result of scientific change in our lives
 - 1.1.2 Beliefs and ideas
 - 1.1.2.1 Describe how scientific discoveries have helped man change his beliefs about the earth and the living things on the earth
 - 1.1.2.2 Describe how superstition has affected the progress of man
 - 1.1.2.3 Identify the three factors necessary for establishing scientific beliefs
 - 1.1.2.4 Define the term "scientific fact"
 - 1.1.2.5 Define assumption
- 1.2 The nature and products of science
 - 1.2.1 Describe how science is accumulated knowledge over the years
 - 1.2.2 Describe how practical application of scientific knowledge has made life easier for man
- 1.3 Attitudes and processes in science
 - 1.3.1 Attitudes associated with scientific inquiry
 - 1.3.1.1 Define attitudes as associated with scientific inquiry
 - 1.3.1.2 Describe the "cause and effect relationship" as a scientific attitude
 - 1.3.1.3 Describe the importance of open-mindedness as a characteristic of scientific endeavor
 - 1.3.2 Methods and processes of science
 - 1.3.2.1 Describe how observation is the basic process for acquiring knowledge
 - 1.3.2.2 Identify classification as the most important process
 - 1.3.2.3 Identify measurement as a process of acquiring quantitative information
 - 1.3.2.4 Describe the importance of recognizing problems as a scientific process
 - 1.3.2.5 Define controlled experimentation, control, experimental factor, and deduction
- 1.4 Life science
 - 1.4.1 Define the term "life science"
 - 1.4.2 Describe how life science is concerned with the conservation of natural resources and with air and water pollution
 - 1.4.3 Describe how life science furnishes a background for those who may be thinking of entering into the fields of medicine, nursing, or other related fields

2.0 LIVING THINGS AND THE CELL

- 2.1 Life activities of plants and animals
 - 2.1.1 Movement
 - 2.1.1.1 Know the need for mobility
 - 2.1.1.2 Define the term "locomotion"
 - 2.1.2 Know that all living things require food to maintain life
 - 2.1.3 Respiration
 - 2.1.3.1 Identify the in-put products of respiration
 - 2.1.3.2 Identify the out-put products of respiration
 - 2.1.3.3 Identify the type of energy released by respiration
 - 2.1.4 Excretion
 - 2.1.4.1 Define the term "excretion"
 - 2.1.4.2 Know the necessity for collection and elimination of waste products from the body
 - 2.1.5 Secretion
 - 2.1.5.1 Know that the production of certain substances is necessary to perform life activities
 - 2.1.5.2 Define the term "secretion"
 - 2.1.6 Irritability
 - 2.1.6.1 Define stimuli and responses
 - 2.1.6.2 Know that certain stimuli and responses are necessary for survival
 - 2.1.7 Reproduction
 - 2.1.7.1 Define the term "reproduction"
 - 2.1.7.2 Know that reproduction is necessary for the survival of the species
 - 2.1.8 Metabolism
 - 2.1.8.1 Define the term "metabolism"
 - 2.1.8.2 Recognize that metabolism is a building up and breaking down process
- 2.2 The basic unit of living things
 - 2.2.1 Cell study
 - 2.2.1.1 Relate Robert Hooke's contribution to the study of cells
 - 2.2.1.2 Relate the invention of the microscope to the study of cells
 - 2.2.1.3 Relate Schleiden's and Schwann's contributions to the cell theory
 - 2.2.2 Cell structure
 - 2.2.2.1 Define the terms "cell" and "protoplasm"
 - 2.2.2.2 Identify the substances that make up protoplasm
 - 2.2.2.3 State what percent of protoplasm is composed of water and what percent is composed of other substances

- 2.2.2.4 Describe the general appearance of protoplasm
- 2.2.2.5 Know that the two main parts of the cell protoplasm are nucleus and cytoplasm
- 2.2.2.6 Identify the structures of the typical animal cell
- 2.2.2.7 Identify the structures of the typical plant cell
- 2.2.2.8 Identify the membrane which encloses the cytoplasm
- 2.2.2.9 Draw and label a typical plant cell and animal cell
- 2.2.3 Cell organization
 - 2.2.3.1 Describe how a tissue is formed
 - 2.2.3.2 List five examples of tissues
 - 2.2.3.3 Describe how tissues group to form organs
 - 2.2.3.4 List five examples of organs
 - 2.2.3.5 Describe how organs organize to form systems in the body
 - 2.2.3.6 List five examples of body systems
 - 2.2.3.7 Describe how a group of systems organize to form a complex organism
 - 2.2.3.8 List five examples of complex organisms
 - 2.2.3.9 Define the term "organism"

3.0 THE WORLD OF LIVING THINGS - PROTISTS AND PLANTS

3.1 Classification of living things

- 3.1.1 Related history
 - 3.1.1.1 Relate Carolus Linnaeus's contribution to the development of a system for naming and classifying organisms
 - 3.1.1.2 Describe the system of "binomial nomenclature"
 - 3.1.1.3 Identify the two names used in the scientific name of an organism
 - 3.1.1.4 Describe the advantage of using scientific names instead of common names
- 3.1.2 Basis of classification
 - 3.1.2.1 Identify structural similarity as a basis for classification
 - 3.1.2.2 Identify the seven divisions of scientific classification
 - 3.1.2.3 Explain reasons for classifying living things into groups
 - 3.1.2.4 Identify the major plant phyla
 - 3.1.2.5 Identify the major animal phyla
 - 3.1.2.6 List one example of each animal phyla
 - 3.1.2.7 Define classification, taxonomy, and taxonomist
 - 3.1.2.8 State the reason for man being placed into phylum Chordata

3.2 The protists - bacteria and others

- 3.2.1 The importance of bacteria
 - 3.2.1.1 Identify some harmful and beneficial bacteria
 - 3.2.1.2 Describe the relationship of bacteria to the nitrogen cycle
 - 3.2.1.3 Identify some uses of bacteria in the field of industry
 - 3.2.1.4 Describe the importance of bacteria that produce decay of organic materials
 - 3.2.1.5 List some pathogenic organisms that invade the human body
- 3.2.2 The structure of bacteria
 - 3.2.2.1 Identify the three main shapes of bacteria
 - 3.2.2.2 Describe the size of bacteria in microns
 - 3.2.2.3 Describe the function of the flagella
 - 3.2.2.4 Know the relationship of spores to bacteria
- 3.2.3 Reproduction in bacteria
 - 3.2.3.1 Define asexual and sexual reproduction
 - 3.2.3.2 Describe asexual reproduction in bacteria
 - 3.2.3.3 Describe sexual reproduction in bacteria
- 3.2.4 Nutrition in bacteria
 - 3.2.4.1 Define autrophic and heterotrophic bacteria
 - 3.2.4.2 List two examples of autrophic and heterotrophic bacteria
 - 3.2.4.3 Define aerobic bacteria
 - 3.2.4.4 Differentiate between aerobic and anaerobic bacteria
- 3.2.5 Distribution of bacteria
 - 3.2.5.1 Know that bacteria is present in the air, in soil, and in water
 - 3.2.5.2 Describe what kind of bacteria are found on land and in water
 - 3.2.5.3 Describe the effects of warmth, moisture, and darkness on the growth and distribution of bacteria
- 3.2.6 The blue-green algae (other protists)
 - 3.2.6.1 The general structure
 - 3.2.6.1.1 Describe the arrangement of the nuclear material and the cytoplasm
 - 3.2.6.1.2 Know that pigment gives blue-green algae its color
 - 3.2.6.2 Other characteristics
 - 3.2.6.2.1 Know the fact that blue-green algae are microscopic in size
 - 3.2.6.2.2 Discuss why some green algae lives individually while others live in colonies
 - 3.2.6.2.3 Identify the habitats of the blue-green algae
 - 3.2.6.2.4 Know that some blue-green algae are harmful and others are not harmful to animals or man
 - 3.2.6.2.5 Know that the process of fission is the means of reproduction of blue-green algae

- 3.2.7 The flagellates
 - 3.2.7.1 The general structure
 - 3.2.7.1.1 Define the term "flagella"
 - 3.2.7.1.2 Describe how the flagellates vary from unicellular to colonial organisms
 - 3.2.7.1.3 Describe the function of the whiplike flagella and its location
 - 3.2.7.1.4 Describe the function of chloroplasts in the animal-like Euglena
 - 3.2.7.1.5 Describe how Volvox represent an association of cells in which there is at least partial specialization and cooperation for carrying on life processes
 - 3.2.7.1.6 Describe the function of the eyespot in the Euglena
 - 3.2.7.2 The habitats and other characteristics
 - 3.2.7.2.1 Know the different kinds of environments of the flagellates
 - 3.2.7.2.2 Identify the flagellate that causes sleeping sickness
 - 3.2.7.2.3 Describe how some flagellates are necessary for an organism to live
 - 3.2.7.2.4 Define parasite and mutualism
 - 3.2.7.2.5 Describe how some flagellates are capable of emitting light
 - 3.2.7.2.6 Describe how the flagellates (marine) produce the "red tides"
- 3.2.8 The rhizopods
 - 3.2.8.1 The general structure
 - 3.2.8.1.1 Describe the rhizopod's one-celled shape
 - 3.2.8.1.2 Describe the appearance of the protoplasm in the Amoeba
 - 3.2.8.1.3 Define and describe pseudopods
 - 3.2.8.1.4 Describe the movement of the Amoeba
 - 3.2.8.1.5 Describe the streaming motion of the cytoplasm as a constant occurrence
 - 3.2.8.1.6 Describe the function of the food and contractile vacuoles
 - 3.2.8.2 The habitat and other characteristics
 - 3.2.8.2.1 Identify the places where the Amoeba live
 - 3.2.8.2.2 Describe how some Amoeba are harmful and others are not
 - 3.2.8.2.3 Identify the Amoeba that can cause amoebic dysentery
 - 3.2.8.2.4 Describe the ways amoebic dysentery is transferred
 - 3.2.8.2.5 Describe how the Amoeba obtains and digests food
 - 3.2.8.2.6 Describe the way the Amoeba respond to light and other stimuli
 - 3.2.8.2.7 Describe how the Amoeba divides by the process of fission
- 3.2.9 The ciliates
 - 3.2.9.1 The general structures
 - 3.2.9.1.1 Define and describe cilia
 - 3.2.9.1.2 Differentiate between the micronucleus and macronucleus
 - 3.2.9.1.3 Define and describe the function of the organelles
 - 3.2.9.2 Other characteristics
 - 3.2.9.2.1 Describe the habitat and occurrence of Paramecium
 - 3.2.9.2.2 State two methods of reproduction of the Paramecium
 - 3.2.9.2.3 Describe the process of conjugation in the Paramecium
 - 3.2.9.2.4 Describe the method of movement in the Paramecium
 - 3.2.9.2.5 Describe how the Paramecium respond to heat, cold, chemicals, the lack of oxygen, and food substances
- 3.3 The algae
 - 3.3.1 Classification and characteristics
 - 3.3.1.1 List the four kinds of algae
 - 3.3.1.2 Know that algae are the simplest green plants
 - 3.3.1.3 Know the types of environments in which algae are found
 - 3.3.1.4 Know that all algae contain chlorophyll or other pigments
 - 3.3.1.5 Know that algae are important food producers
 - 3.3.1.6 Describe how the algae trap the sun's energy and manufacture food
 - 3.3.2 The general structure and appearance
 - 3.3.2.1 Describe how algae may be single-celled or filaments of cells
 - 3.3.2.2 List two kinds of green algae that are most common
 - 3.3.2.3 Describe the use of kelp as a food producer
 - 3.3.2.4 Describe the use of algin produced by the brown algae
 - 3.3.2.5 Describe the feathery appearance of the red algae
 - 3.3.2.6 Recognize that red algae is a source of agar-agar
- 3.4 The fungi
 - 3.4.1 General structure
 - 3.4.1.1 Know that fungi do not contain the substance chlorophyll
 - 3.4.1.2 Define and describe hyphae in fungi
 - 3.4.1.3 Define and describe mycelium in fungi
 - 3.4.1.4 Describe the function of the stipe, cap, annulus, and gills in fungi
 - 3.4.2 Nutrition in fungi
 - 3.4.2.1 Name and identify the parasitic fungi
 - 3.4.2.2 Name and identify the saprophytic fungi
 - 3.4.2.3 Describe how fungi secrete enzymes capable of acting on materials and making them useable for life processes

- 3.4.2.4 Describe how some fungi reproduce by forming spores in such large numbers that they reach the majority of places where food is available
- 3.4.3 Classification and reproduction
 - 3.4.3.1 Identify some common representatives of fungi
 - 3.4.3.2 Describe the difference between the reproductive structure and the vegetative part of the mushroom
- 3.4.4 Importance of fungi
 - 3.4.4.1 Identify those fungi that are used for food by man
 - 3.4.4.2 Identify those fungi that are used as medicine
 - 3.4.4.3 Identify those fungi that cause decay and decomposition of animal and plant matter
 - 3.4.4.4 Describe the uses of yeast in different industries
- 3.5 The mosses
 - 3.5.1 General structures and characteristics
 - 3.5.1.1 Describe the multicellular appearance of mosses
 - 3.5.1.2 Know that the mosses are the simplest plants existing on land
 - 3.5.1.3 Know that mosses do not have roots
 - 3.5.1.4 Describe the vascular system of the mosses
 - 3.5.1.5 Know that the roots are replaced by rootlike structures called rhizoids in the mosses
 - 3.5.1.6 Know the average height and the distribution of mosses
 - 3.5.2 Reproduction in mosses
 - 3.5.2.1 Define "alternation of generations"
 - 3.5.3 Uses of mosses
 - 3.5.3.1 Describe how dried sphagnum is used by florists as a mulch
 - 3.5.3.2 Know that sphagnum moss is the source of peat
 - 3.5.3.3 Describe how decayed sphagnum moss is a valuable fuel source
- 3.6 The club mosses, horsetails, and ferns
 - 3.6.1 Structures and habitats
 - 3.6.1.1 Know the club mosses, horsetails, and ferns as members of phylum Tracheophyta
 - 3.6.1.2 Know that plants in phylum Tracheophyta have vascular tissue composed of phloem and xylem
 - 3.6.1.3 Explain the function of the xylem as a conducting tissue
 - 3.6.1.4 Explain the function of the phloem as a conducting tissue
 - 3.6.1.5 Know that the members of Tracheophyta have true roots, stems, and leaves
 - 3.6.1.6 Describe the type of woodlands which are the habitat of the club mosses
 - 3.6.1.7 Describe the different types of ferns that are found in the woods, temperate regions, and the tropics
 - 3.6.1.8 Identify epiphyte
 - 3.6.1.9 Define and describe frond
 - 3.6.2 Uses of club mosses, horsetails, and ferns
 - 3.6.2.1 Describe how the club mosses are often used in making Christmas wreaths
 - 3.6.2.2 Know that the remains of the club moss are important components of coal
 - 3.6.2.3 Identify the component of horsetails that is useful in making scouring pads to clean pots and pans
 - 3.6.2.4 Name some common fern types grown in homes
 - 3.6.3 Reproduction in the club mosses, horsetails and ferns
 - 3.6.3.1 Know that club mosses, horsetails, and ferns are nonflowering seed plants or gymnosperms
 - 3.6.3.2 Describe the sporophyte and gametophyte generation of the club mosses, horsetails, and ferns
- 3.7 Gymnosperms
 - 3.7.1 Characteristics and structures
 - 3.7.1.1 Know that the gymnosperms are nonflowering seed plants
 - 3.7.1.2 Know that the gymnosperms have true leaves, stems, and roots
 - 3.7.1.3 Describe the leaves of the gymnosperms
 - 3.7.1.4 Know that there are some 500 species of gymnosperms
 - 3.7.1.5 List six examples of gymnosperms
 - 3.7.1.6 Describe the habitats of the gymnosperms
 - 3.7.1.7 Define conifers
 - 3.7.1.8 Define and describe evergreens
 - 3.7.1.9 List five examples of evergreens
 - 3.7.2 Importance and uses of gymnosperms
 - 3.7.2.1 Know that the Ginkgo or maidenhair tree is called the living fossil
 - 3.7.2.2 Know that the Ginkgo is widely used in cities where air pollution often kills other trees
 - 3.7.2.3 Name some of the products produced from evergreen trees
- 3.8 Angiosperms
 - 3.8.1 Characteristics and structures
 - 3.8.1.1 Identify the type of flowering plants that are called angiosperms
 - 3.8.1.2 Know that angiosperms are the most highly developed plants
 - 3.8.1.3 Discuss the diversity in flowers, seeds, and fruits of angiosperms
 - 3.8.1.4 Describe the ability of angiosperms to live in many types of environments
 - 3.8.1.5 Identify the characteristics of angiosperms that classifies them as photosynthesizing plants

- 3.8.1.6 Define annuals, biennials, and perennials
- 3.8.1.7 Identify the two main subgroups of the angiosperms as being monocotyledons and the dicotyledons
- 3.8.2 Reproduction in angiosperms
 - 3.8.2.1 The flower and its structures
 - 3.8.2.1.1 Know the function of the flower
 - 3.8.2.1.2 Recognize the great diversity in flowers
 - 3.8.2.1.3 Identify the parts of a flower
 - 3.8.2.1.4 Describe the function of each part of a flower
 - 3.8.2.1.5 Define fertilization
 - 3.8.2.2 The seeds and fruits
 - 3.8.2.2.1 Describe the formation of the seed
 - 3.8.2.2.2 Define seed
 - 3.8.2.2.3 Identify what is found inside the seed
 - 3.8.2.2.4 Define and describe cotyledons
 - 3.8.2.2.5 List five examples of monocotyledon and dicotyledon seeds
 - 3.8.2.2.6 Define fruit
- 3.8.3 Other features of the angiosperms
 - 3.8.3.1 Roots
 - 3.8.3.1.1 Describe the function of roots
 - 3.8.3.1.2 Identify the two types of roots
 - 3.8.3.1.3 Know the function of tap-roots
 - 3.8.3.1.4 Know the function of fibrous-roots
 - 3.8.3.1.5 Define adventitious roots
 - 3.8.3.1.6 Define prop roots
 - 3.8.3.1.7 Describe the region called the embryonic or meristem
 - 3.8.3.1.8 Describe the function of the root cap
 - 3.8.3.1.9 Define and describe the function of the stele or central cylinder
 - 3.8.3.1.10 Describe the location and function of the root hairs
 - 3.8.3.1.11 Describe the cortex and its function
 - 3.8.3.1.12 Describe the function of the xylem and phloem cells
 - 3.8.3.1.13 Define cambium and describe its function
 - 3.8.3.1.14 Describe how the phloem and xylem constitute a vascular bundle
 - 3.8.3.2 Stems
 - 3.8.3.2.1 Know the function of stems
 - 3.8.3.2.2 Describe the formation of stems
 - 3.8.3.2.3 Locate the place where the meristem tissue is located
 - 3.8.3.2.4 Locate the place where stem growth occurs
 - 3.8.3.2.5 Describe the function of the lateral buds
 - 3.8.3.2.6 Identify and name the structures that develop from nodes
 - 3.8.3.2.7 Describe leaf scars and what they represent
 - 3.8.3.2.8 Define and describe a bundle scar
 - 3.8.3.2.9 Define and describe a vascular bundle
 - 3.8.3.2.10 Define internodes and describe their location
 - 3.8.3.2.11 Define lenticels and describe their location
 - 3.8.3.2.12 Explain the arrangement of the vascular bundles in the stem of monocot and dicot stems
 - 3.8.3.2.13 Describe the function of cambium
 - 3.8.3.2.14 Know when the cambium cells are most actively dividing
 - 3.8.3.2.15 Describe the location of the cambium in relative position to the phloem and xylem
 - 3.8.3.2.16 Define and describe annual rings
 - 3.8.3.2.17 State the usefulness of the annual rings
 - 3.8.3.2.18 Define pith cells and describe their location in a dicot stem
 - 3.8.3.3 Leaves
 - 3.8.3.3.1 Know the main function of the leaf
 - 3.8.3.3.2 Describe the location and function of the chloroplasts
 - 3.8.3.3.3 Describe the function and location of the stomates and guard cells
 - 3.8.3.3.4 Identify the petiole and describe its location on the leaf
 - 3.8.3.3.5 Differentiate between a simple and compound leaf
 - 3.8.3.3.6 Define tendril
 - 3.8.3.3.7 Describe the way vascular bundles appear as veins in leaves
 - 3.8.3.3.8 Describe the arrangement of veins in monocot and dicot leaves
 - 3.8.3.3.9 Define transpiration and state how it affects the leaf

4.0 THE WORLD OF LIVING THINGS - ANIMALS

4.1 General features of animals

- 4.1.1 Differences between plants and animals
 - 4.1.1.1 Differentiate between the structural organization of plants and animals
 - 4.1.1.2 Differentiate between the methods and ability of movement in plants and animals
 - 4.1.1.3 Describe the ability of animals to receive stimuli and transmit messages
 - 4.1.1.4 Recognize that animals cannot make their own food

- 4.1.2 Adaptations
 - 4.1.2.1 Define adaptations and list some adaptations in animals
 - 4.1.2.2 Define habitat
 - 4.1.2.3 Describe the relationship between the types of habitats and adaptations needed by animals
 - 4.1.2.4 Know selected adaptations of terrestrial animals
 - 4.1.2.5 Describe some adaptations of marine animals
 - 4.1.2.6 Define hibernation
 - 4.1.2.7 Describe some adaptations of aquatic animals
- 4.1.3 Other adaptations
 - 4.1.3.1 Adaptation for protection
 - 4.1.3.1.1 Name the adaptations for protection for the following animals: sponges, birds, fish, deer, turtles, bees, toads, stink bugs, skunks, and butterflies
 - 4.1.3.1.2 Describe how coloration or camouflage is used by animals
 - 4.1.3.1.3 Describe the adaptation mimicry and identify an animal that uses mimicry
 - 4.1.3.2 Adaptations for securing food
 - 4.1.3.2.1 Describe how the methods used by animals to secure food are adaptations
 - 4.1.3.2.2 Define carnivorous animals
 - 4.1.3.2.3 Define herbivorous animals
 - 4.1.3.2.4 Describe the adaptations of the carnivorous and herbivorous animals for securing and eating their food
 - 4.1.3.2.5 Define omnivorous animals
- 4.1.4 Some characteristics used to classify animals
 - 4.1.4.1 Differentiate between vertebrates and invertebrates
 - 4.1.4.2 Describe how symmetry is used to classify some animals
 - 4.1.4.3 Define symmetry
 - 4.1.4.4 Describe how segmentation is used to classify certain animals
 - 4.1.4.5 Describe how the types of tissue layers are used to classify animals
 - 4.1.4.6 Describe how the type of skeleton is another feature used to classify animals
 - 4.1.4.7 Define exoskeleton
 - 4.1.4.8 Describe how the various types of systems are used as a basis for classifying animals
- 4.1.5 Some simpler animals
 - 4.1.5.1 Sponges - characteristics and structures
 - 4.1.5.1.1 Describe the appearance of various sponges
 - 4.1.5.1.2 Know the habitat of sponges
 - 4.1.5.1.3 Know the uses of sponges
 - 4.1.5.1.4 Describe how commercial sponges are derived from living sponges
 - 4.1.5.1.5 Know the types of cellular organization of sponges
 - 4.1.5.1.6 Define spicules
 - 4.1.5.1.7 Describe how the spicules are used to differentiate the different species of sponges
 - 4.1.5.1.8 Describe the ability of sponges to regenerate
 - 4.1.5.1.9 Describe how man takes advantage of the sponge regenerative ability
 - 4.1.5.2 Coelenterates - structures and features
 - 4.1.5.2.1 Identify the appearance of the coelenterates
 - 4.1.5.2.2 Describe the shapes of the coelenterates
 - 4.1.5.2.3 List two examples of the coelenterates
 - 4.1.5.2.4 Describe the function of the tentacles
 - 4.1.5.2.5 Describe the characteristic of luminescence
 - 4.1.5.2.6 Describe how the coelenterates get their food
 - 4.1.5.3 Flatworms - characteristics and structures
 - 4.1.5.3.1 Describe how flatworms get their names
 - 4.1.5.3.2 List some examples of flatworms
 - 4.1.5.3.3 Know the types of symmetry exhibited by the flatworms
 - 4.1.5.3.4 Know the habitat of some flatworms
 - 4.1.5.3.5 Describe the life cycles of some of the most common flatworms
 - 4.1.5.3.6 Relate the fact that many flatworms are parasites
 - 4.1.5.3.7 Describe the way some parasitic flatworms may enter into the human body
 - 4.1.5.3.8 List some common flatworms that can live in man's body
 - 4.1.5.4 Roundworms - characteristics and structures
 - 4.1.5.4.1 Describe the shape, size, and length of the typical roundworm
 - 4.1.5.4.2 Describe the type of digestive system found in the roundworms
 - 4.1.5.4.3 Describe the type of symmetry found in roundworms
 - 4.1.5.4.4 Identify the habitat of the roundworms
 - 4.1.5.4.5 List some examples of roundworms
 - 4.1.5.4.6 List some diseases in man caused by parasitic roundworms
 - 4.1.5.4.7 Describe the life cycle of a parasitic roundworm in man
 - 4.1.5.4.8 Know the methods or ways in which these parasitic roundworms may enter the body

- 4.1.5.4.9 Describe what is necessary for prevention of infectious roundworms
- 4.1.5.5 Rotifers - characteristics
 - 4.1.5.5.1 Identify the places where rotifers are found
 - 4.1.5.5.2 Describe the appearance of the rotifers
 - 4.1.5.5.3 Know the type of symmetry found in the rotifers
 - 4.1.5.5.4 Describe the types of food eaten by rotifers
 - 4.1.5.5.5 Describe how reproduction occurs in rotifers
 - 4.1.5.5.6 Define parthenogenetic development
- 4.1.6 The higher invertebrates
 - 4.1.6.1 Mollusks
 - 4.1.6.1.1 Know the habitat of the mollusks
 - 4.1.6.1.2 Describe the structural appearance of the mollusks
 - 4.1.6.1.3 Describe the structure used for motion in mollusks
 - 4.1.6.1.4 List some members of the mollusks family
 - 4.1.6.1.5 Describe the type of digestive system of the mollusks
 - 4.1.6.1.6 Describe what is known as the open circulatory system in the mollusks
 - 4.1.6.1.7 Identify those mollusks that are used by man for food
 - 4.1.6.1.8 Identify some of the other economical uses of mollusks
 - 4.1.6.2 Segmented worms
 - 4.1.6.2.1 Describe the external appearance of the segmented worms
 - 4.1.6.2.2 Describe the internal structures of the segmented worms
 - 4.1.6.2.3 Know the reason for calling these worms segmented worms
 - 4.1.6.2.4 List some representatives of segmented worms
 - 4.1.6.2.5 Describe the way these worms take in oxygen
 - 4.1.6.2.6 Describe the presence of a muscular system in segmented worms
 - 4.1.6.2.7 Describe the nervous system of the segmented worms
 - 4.1.6.2.8 Know the habitats of the segmented worms
 - 4.1.6.2.9 Describe the way the segmented worms get their food
 - 4.1.6.3 Arthropods
 - 4.1.6.3.1 Identify some of the most familiar arthropods
 - 4.1.6.3.2 Describe the habitats of the arthropods
 - 4.1.6.3.3 Describe how the arthropods derived their name
 - 4.1.6.3.4 Identify some of the adaptative features of their appendages
 - 4.1.6.3.5 Identify the three main body parts of the arthropods
 - 4.1.6.3.6 Describe how their bodies are protected
 - 4.1.6.3.7 Define and describe molting in the arthropods
 - 4.1.6.3.8 Describe the life cycle of the arthropods
 - 4.1.6.3.9 Define metamorphosis and list the various stages of metamorphosis
 - 4.1.6.3.10 Describe the nervous system of the arthropods
 - 4.1.6.3.11 List some of the important sense organs of the arthropods
 - 4.1.6.3.12 Describe the "open system" found in the arthropods
 - 4.1.6.3.13 List the five classes of arthropods
 - 4.1.6.3.14 Define entomology
 - 4.1.6.3.15 Define nymphs and describe their function
 - 4.1.6.3.16 Know the characteristics of the class of insects
 - 4.1.6.3.17 Name those insects which are classified as social insects
 - 4.1.6.3.18 Know the ways in which insects are beneficial to man
 - 4.1.6.3.19 Know the ways in which insects are harmful to man
 - 4.1.6.3.20 List some useful products obtained from certain insects
- 4.1.7 The vertebrates or higher animals
 - 4.1.7.1 Characteristics and structures
 - 4.1.7.1.1 List some common examples of vertebrates
 - 4.1.7.1.2 Name the phylum to which the vertebrates belong
 - 4.1.7.1.3 Know the type of symmetry found in the vertebrates
 - 4.1.7.1.4 Know the three germ layers found in the vertebrates
 - 4.1.7.1.5 Describe the digestive tract of the vertebrates
 - 4.1.7.1.6 Describe the early development of the vertebrates
 - 4.1.7.1.7 Describe the vertebrae and their function
 - 4.1.7.2 Vertebrate class - fishes
 - 4.1.7.2.1 Describe the structures of the jawless fish
 - 4.1.7.2.2 List some examples of jawless fish
 - 4.1.7.2.3 Know the habitats of the jawless fish
 - 4.1.7.2.4 Know those fish which are grouped as cartilaginous
 - 4.1.7.2.5 Describe the structural makeup of the cartilaginous fish
 - 4.1.7.2.6 Name the fish which are grouped as bony fish
 - 4.1.7.2.7 Describe the structural makeup of the bony fish
 - 4.1.7.2.8 Define operculum
 - 4.1.7.2.9 Describe how fish get oxygen
 - 4.1.7.2.10 Describe the waste removal process in fish
 - 4.1.7.2.11 Name the external structures of most bony fish
 - 4.1.7.2.12 Name the internal structures of the bony fish
 - 4.1.7.2.13 Describe the adaptation of having a lateral line and its function

- 4.1.7.2.14 Relate the fact that some bony fish have the ability to change color
- 4.1.7.3 Vertebrate class - amphibians
 - 4.1.7.3.1 Identify those animals that are classed as amphibians
 - 4.1.7.3.2 Describe the skin of an amphibian
 - 4.1.7.3.3 Know the number of limbs of amphibians
 - 4.1.7.3.4 Describe the function of the nostrils of amphibians
 - 4.1.7.3.5 Describe the type of heart an amphibian possesses
 - 4.1.7.3.6 Describe the development from egg to adult of amphibians
 - 4.1.7.3.7 Describe how the amphibians got their names
 - 4.1.7.3.8 Differentiate between the habitat of frogs and toads
 - 4.1.7.3.9 Describe the function of the web feet of amphibians
 - 4.1.7.3.10 Describe the function of the tongue of amphibians
 - 4.1.7.3.11 Describe how the amphibians get oxygen
 - 4.1.7.3.12 Explain why frogs hibernate
 - 4.1.7.3.13 Describe the relationship between the salamanders and frogs
- 4.1.7.4 Vertebrate class - reptiles
 - 4.1.7.4.1 Identify some animals that are classified as reptiles
 - 4.1.7.4.2 Describe the skin of a reptile
 - 4.1.7.4.3 Know the number of limbs a reptile possesses
 - 4.1.7.4.4 List those reptiles which possess shells
 - 4.1.7.4.5 Describe the type of heart found in reptiles
 - 4.1.7.4.6 Describe how the reptiles breathe
 - 4.1.7.4.7 Describe the reproductive process in reptiles
 - 4.1.7.4.8 Identify those snakes which are classified as poisonous
 - 4.1.7.4.9 Identify those snakes which are classified as non-poisonous
 - 4.1.7.4.10 List some adaptations of various snakes
 - 4.1.7.4.11 Describe ways to distinguish poisonous snakes from non-poisonous snakes
 - 4.1.7.4.12 Describe how certain snakes help to maintain the balance of nature
 - 4.1.7.4.13 List some common types of lizards found in the United States
 - 4.1.7.4.14 Describe the external appearance of lizards
 - 4.1.7.4.15 Differentiate between a turtle and a tortoise
 - 4.1.7.4.16 Describe the features of an alligator that distinguish it from a crocodile
- 4.1.7.5 Vertebrate class - birds
 - 4.1.7.5.1 Identify the feature which separates birds from all other vertebrates
 - 4.1.7.5.2 Describe the physical adaptations of birds necessary for flight
 - 4.1.7.5.3 Describe the adaptations which enable birds to feed and build nests
 - 4.1.7.5.4 Illustrate some familiar beak shapes of birds
 - 4.1.7.5.5 Describe how the type of feet is an adaptation of birds
 - 4.1.7.5.6 Describe how the sense of sight and the sense of hearing is an adaptation needed by birds
 - 4.1.7.5.7 Describe how the birds use their voice box during certain seasons or occasions
 - 4.1.7.5.8 Describe the habitats of certain birds
 - 4.1.7.5.9 Identify the birds common to our region of the country
 - 4.1.7.5.10 Describe the reproductive process in birds
 - 4.1.7.5.11 Relate the importance of certain birds
 - 4.1.7.5.12 List some birds that are used for food by man
 - 4.1.7.5.13 List some birds that are pets of man
- 4.1.7.6 Vertebrate class - mammals
 - 4.1.7.6.1 Identify the features that place certain animals in the mammal category
 - 4.1.7.6.2 Name the three subclasses of mammals
 - 4.1.7.6.3 Identify the feature which place certain animals into certain subclasses
 - 4.1.7.6.4 Describe the type of heart the mammals possess
 - 4.1.7.6.5 Describe the features which place man in this class
 - 4.1.7.6.6 List the habitats of the lower mammals

5.0 CHEMICAL AND PHYSICAL NATURE OF LIVING MATTER

5.1 The particles that make up matter

5.1.1 Molecules

- 5.1.1.1 Define matter
- 5.1.1.2 Define molecule
- 5.1.1.3 Know that molecules are in constant motion
- 5.1.1.4 Describe the "Brownian movement" of molecules
- 5.1.1.5 Describe the process of diffusion

5.1.2 Elements

- 5.1.2.1 Define elements
- 5.1.2.2 List ten examples of elements

- 5.1.2.3 State the number of known elements known to man
- 5.1.2.4 Know that symbols are used to designate elements
- 5.1.2.5 State the number of elements that occur in nature
- 5.1.2.6 State the number of elements that have been prepared artificially
- 5.1.2.7 State the number of elements that make up living matter
- 5.1.2.8 Define atom
- 5.1.2.9 Describe the relationship between the atom and an element
- 5.1.2.10 Describe the structure of an atom
- 5.1.2.11 Describe the "nucleus" of an atom
- 5.1.2.12 Know the name of two types of particles that make up the nucleus of an atom
- 5.1.2.13 Know the type of charge possessed by the protons
- 5.1.2.14 Know the type of charge possessed by the neutrons
- 5.1.2.15 Know the type of charge possessed by the electrons
- 5.1.2.16 Define atomic number
- 5.1.2.17 Describe the relationship between atomic number and the number of electrons in an atom of an element
- 5.1.3 Electrons
 - 5.1.3.1 Describe the importance of electrons in chemical reactions
 - 5.1.3.2 Describe the motion of electrons
 - 5.1.3.3 Describe the action of electrons in chemical reactions
 - 5.1.3.4 Define ions
 - 5.1.3.5 Describe the relationship between an atom and its ion
- 5.1.4 Chemical bonds
 - 5.1.4.1 Define chemical bond
 - 5.1.4.2 Describe the two ways in which chemical bonds are formed
 - 5.1.4.3 Define ionic bond
 - 5.1.4.4 Describe the formation of ionic bonds
 - 5.1.4.5 Define covalent bonds
 - 5.1.4.6 Describe the formation of covalent bonds
 - 5.1.4.7 Define the collision theory
 - 5.1.4.8 Explain the collision theory and its relationship to atoms and molecules
 - 5.1.4.9 Define chemical reaction
 - 5.1.4.10 Describe what constitutes a chemical reaction
- 5.1.5 Atomic weight
 - 5.1.5.1 Define atomic weight
 - 5.1.5.2 Describe how the atomic weight of an element is derived
 - 5.1.5.3 Know the atomic weight of ten common elements
 - 5.1.4.4 Define covalent bonds
 - 5.1.4.5 Define the collision theory
 - 5.1.4.6 Explain the collision theory and its relationship to atoms and molecules
 - 5.1.4.7 Define chemical reaction
 - 5.1.4.8 Describe what constitutes a chemical reaction
- 5.2 The nature of the
 - 5.2.1 Compounds
 - 5.2.1.1 Define compound
 - 5.2.1.2 List ten examples of compounds used daily
 - 5.2.1.3 Name the components of compounds
 - 5.2.1.4 Describe what holds elements of a compound together
 - 5.2.1.5 Know two types of properties found in compounds
 - 5.2.1.6 Describe some of the ways in which compounds may be broken down or decomposed
 - 5.2.1.7 Describe what is meant by a physical change
 - 5.2.1.8 Describe three common physical changes
 - 5.2.1.9 Describe what is meant by chemical change
 - 5.2.1.10 List three examples of chemical changes
 - 5.2.2 Mixtures
 - 5.2.2.1 Define mixture
 - 5.2.2.2 List five examples of mixtures
 - 5.2.2.3 Describe the major difference between a compound and a mixture
 - 5.2.2.4 Name the most important mixture in our lives
 - 5.2.3 Solutions and suspensions
 - 5.2.3.1 Define solution
 - 5.2.3.2 List five examples of solutions
 - 5.2.3.3 Define solute
 - 5.2.3.4 Define solvent
 - 5.2.3.5 Describe the relationship of the solute to the solvent in a solution
 - 5.2.3.6 Define homogeneous mixture
 - 5.2.3.7 Describe the distribution of particles in a homogeneous mixture
 - 5.2.3.8 Know the "universal solvent"
 - 5.2.3.9 Define suspension
 - 5.2.3.10 Describe the difference between a solution and a suspension
 - 5.2.4 Inorganic and organic substances
 - 5.2.4.1 Define inorganic substances or inorganic compounds

- 5.2.4.2 List five examples of inorganic substances
- 5.2.4.3 Define organic compounds
- 5.2.4.4 List five examples of organic compounds
- 5.2.4.5 Know the importance of organic compounds in living things
- 5.2.4.6 Know the four main organic compounds found in living matter
- 5.2.4.7 Know the element found in all organic compounds
- 5.3 The nature of the substances in living matter
 - 5.3.1 Inorganic substances in protoplasm
 - 5.3.1.1 Know the major inorganic substances found in protoplasm
 - 5.3.1.2 Describe the importance of water in protoplasm
 - 5.3.1.3 Describe the importance of water in the bodies of living things
 - 5.3.1.4 List two of the uses of water in carrying out various life processes
 - 5.3.1.5 Describe what is meant by dissociation of a substance
 - 5.3.1.6 Define acid
 - 5.3.1.7 Describe how an acid solution may be identified
 - 5.3.1.8 Define base
 - 5.3.1.9 Describe how a basic solution may be identified
 - 5.3.1.10 Define neutral as compared to acid and base
 - 5.3.1.11 Describe the importance of the protoplasm maintaining a certain acid-basic condition
 - 5.3.1.12 Describe the importance of oxygen in living things
 - 5.3.1.13 Describe how oxygen is used by plants and animals
 - 5.3.1.14 Describe the importance of nitrogen in living things
 - 5.3.1.15 Describe the importance of minerals in living things
 - 5.3.1.16 Know the percent (by weight) of mineral substances found in protoplasm
 - 5.3.1.17 Know that the mineral salts are classified into two groups by their uses in living things
 - 5.3.1.18 Name the micronutrients needed in relatively large amounts by living things
 - 5.3.1.19 Name the micronutrients needed in relatively small amounts by living things
 - 5.3.1.20 Define hemoglobin
 - 5.3.1.21 List two trace elements needed by animals that are not needed by plants
 - 5.3.2 Organic substances
 - 5.3.2.1 Name the four main substances (organic) found in living matter
 - 5.3.2.2 Name the elements found in carbohydrates
 - 5.3.2.3 Know the function of carbohydrates in living things
 - 5.3.2.4 List three examples of carbohydrates
 - 5.3.2.5 Define monosaccharides
 - 5.3.2.6 List an example of a monosaccharide
 - 5.3.2.7 Compare the number of hydrogen atoms to the number of oxygen atoms in monosaccharides
 - 5.3.2.8 Describe the importance of glucose
 - 5.3.2.9 Describe how glucose makes energy available for use in living things
 - 5.3.2.10 List the six most common sugars
 - 5.3.2.11 Describe the role of simple sugars in the making of complex carbohydrates
 - 5.3.2.12 Define polysaccharide
 - 5.3.2.13 Name the structure in a plant cell that contains a polysaccharide
 - 5.3.2.14 Define glycogen
 - 5.3.2.15 Describe the function of glycogen in animals
 - 5.3.3 Lipids or fats
 - 5.3.3.1 Define lipids
 - 5.3.3.2 List three examples of lipids
 - 5.3.3.3 Define true fats
 - 5.3.3.4 List two examples of true fats
 - 5.3.3.5 Identify the ratio of hydrogen to oxygen in the lipid compounds
 - 5.3.3.6 Name the components of a fat molecule
 - 5.3.3.7 Define steroids
 - 5.3.3.8 Name some substances that belong to the steroid group
 - 5.3.3.9 Know the function and importance of fats in the cell
 - 5.3.4 Proteins
 - 5.3.4.1 Describe the importance of proteins in the protoplasm
 - 5.3.4.2 Describe the distribution of proteins in living things
 - 5.3.4.3 Name the basic elements found in proteins
 - 5.3.4.4 Know the building blocks of proteins
 - 5.3.4.5 Know the approximate number of amino acids in nature
 - 5.3.4.6 Describe the amino acid general formula
 - 5.3.4.7 Define antibodies
 - 5.3.4.8 Describe the relationship between proteins and antibodies
 - 5.3.4.9 Define hormone
 - 5.3.4.10 Describe the relationship between proteins and hormones
 - 5.3.4.11 Define enzyme
 - 5.3.4.12 Describe the relation between enzymes and proteins
 - 5.3.5 Nucleic acids
 - 5.3.5.1 Describe the function of the nucleic acids
 - 5.3.5.2 Name the two kinds of nucleic acids
 - 5.3.5.3 Describe the appearance of the nucleic acids

- 5.3.5.4 Know the building blocks of the nucleic acids
 - 5.3.5.5 Relate Watson and Crick to the development of the DNA model
- 5.4 The role of energy in living things
 - 5.4.1 Energy
 - 5.4.1.1 Define energy
 - 5.4.1.2 Name the two general kinds of energy
 - 5.4.1.3 Define potential energy
 - 5.4.1.4 Define kinetic energy
 - 5.4.1.5 Describe how energy can be classified into certain forms
 - 5.4.1.6 List five forms of energy
 - 5.4.1.7 Describe how energy forms can be transformed into other forms
 - 5.4.2 Energy and the life processes
 - 5.4.2.1 Describe the source of energy in living things
 - 5.4.2.2 Name the form of energy found in foods
 - 5.4.2.3 Know the most important energy form supplying substance for the life processes
 - 5.4.2.4 Identify foods that are a source of energy for the life processes
 - 5.4.2.5 Define oxidation
 - 5.4.2.6 Describe the importance of oxidation in living things
 - 5.4.2.7 Describe how oxidation occurs in living things
 - 5.4.2.8 Define reduction
 - 5.4.2.9 Describe the contrast between reduction and oxidation
- 5.5 The nature of protoplasm
 - 5.5.1 Some general features
 - 5.5.1.1 Describe the appearance of protoplasm
 - 5.5.1.2 Identify the protoplasmic structures
 - 5.5.1.3 Name the most abundant constituent of protoplasm
 - 5.5.2 Protoplasm - colloidal nature
 - 5.5.2.1 Describe the colloidal nature of protoplasm
 - 5.5.2.2 Describe the sol state of protoplasm
 - 5.5.2.3 Describe the ge. state of protoplasm
 - 5.5.3 Protoplasm - its dynamic nature
 - 5.5.3.1 Describe what is meant by the dynamic nature of protoplasm
 - 5.5.3.2 Define metabolism
 - 5.5.3.3 Know the two steps in metabolism
 - 5.5.3.4 Differentiate between the anabolism and catabolism phases of metabolism

6.0 THE ROLE OF GREEN PLANTS IN ENERGY TRANSFORMATIONS - PHOTOSYNTHESIS

- 6.1 Photosynthesis
 - 6.1.1 What is photosynthesis?
 - 6.1.1.1 Define photosynthesis
 - 6.1.1.2 Describe what happens to the absorbed energy in photosynthesis
 - 6.1.1.3 Name the type of food produced by photosynthesis
 - 6.1.1.4 Know the in-put products of photosynthesis
 - 6.1.1.5 Name the chemical pigment that is necessary for photosynthesis to occur
 - 6.1.1.6 Know the end-products of photosynthesis
 - 6.1.1.7 Relate some of the present concepts of how photosynthesis occurs
 - 6.1.1.8 Relate the contributions of the following to the study of photosynthesis:
(1) Aristotle, (2) Van Helmont, (3) Priestly, (4) Jan Ingen-Hausz, (5) Samuel Ruben, (6) Senebier, (7) De Saussure, (8) Dutrochet, (9) Julius Sachs, (10) Dr. Melvin Calvin, and (11) Dr. Daniel I. Arnon
 - 6.1.1.9 Define the dark-phase of photosynthesis
 - 6.1.1.10 Describe how the light-phase and the dark-phase of photosynthesis depend upon each other
 - 6.1.2 State the modern equation for photosynthesis
 - 6.1.3 Raw materials and other essentials for photosynthesis
 - 6.1.3.1 Know the basic raw materials needed for photosynthesis
 - 6.1.3.2 Know the source of carbon dioxide used in photosynthesis
 - 6.1.3.3 Know the source of water used in photosynthesis
 - 6.1.3.4 Know the process by which leaves obtain carbon dioxide
 - 6.1.3.5 Describe the ways in which land plants obtain water
 - 6.1.3.6 Describe the special process by which water enters the plant
 - 6.1.3.7 Define enzymes
 - 6.1.3.8 Describe the role of catalysts in the photosynthetic process
 - 6.1.4 The end-products of photosynthesis
 - 6.1.4.1 Name the two end-products of photosynthesis
 - 6.1.4.2 Describe the importance of glucose in plants and in other living things
 - 6.1.4.3 Describe how oxygen is formed in photosynthesis
 - 6.1.4.4 Describe how oxygen is released by plants
 - 6.1.4.5 Describe the process that is dependent upon the oxygen supplied by photosynthesis
 - 6.1.5 Organisms classified on the basis of their source of energy
 - 6.1.5.1 Define autotrophs
 - 6.1.5.2 Identify the two kinds of autotrophic organisms
 - 6.1.5.3 Describe the importance of the photosynthetic autotrophs

- 6.1.5.4 Define chemosynthetic autotrophs
- 6.1.5.5 Identify some examples of chemosynthetic autotrophs
- 6.1.5.6 Define heterotrophic organisms
- 6.1.5.7 List some examples of heterotrophic organisms

7.0 THE NATURE OF CELLULAR ACTIVITY - CELLULAR METABOLISM

- 7.1 General features of cellular metabolism
 - 7.1.1 Metabolism - anabolism and catabolism
 - 7.1.1.1 Describe the process of cellular metabolism
 - 7.1.1.2 Identify the two processes involved in metabolism
 - 7.1.1.3 Describe the process of anabolism in cellular metabolism
 - 7.1.1.4 Describe the process of catabolism in cellular metabolism
 - 7.1.1.5 List an example of anabolism
 - 7.1.1.6 List an example of catabolism
 - 7.1.2 Energy transformations
 - 7.1.2.1 Describe the necessity for energy transformations in the cell
 - 7.1.2.2 List some of the activities energy is needed for in the body
 - 7.1.2.3 Describe how cells obtain needed energy to carry on life activities
 - 7.1.2.4 Name the chemical substance that is an immediate energy source for the cell
 - 7.1.2.5 Describe how energy is transferred from foods to ATP
 - 7.1.3 Enzymes
 - 7.1.3.1 Define enzymes
 - 7.1.3.2 Describe the function of enzymes in cellular metabolism
 - 7.1.3.3 Describe some of the activities that are dependent upon enzyme action
 - 7.1.4 Utilization of raw materials
 - 7.1.4.1 Explain the need for raw materials
 - 7.1.4.2 Describe the use of the raw materials in metabolism
 - 7.1.4.3 Know the substances that must be removed before metabolism can occur properly
 - 7.1.4.4 List some examples of metabolic waste
 - 7.1.5 Homeostasis
 - 7.1.5.1 Define homeostasis
 - 7.1.5.2 Describe the importance of homeostasis in the activities of living things
 - 7.1.5.3 Describe what is meant by "self-regulating processes"
 - 7.1.5.4 List some examples of self-regulating processes
- 7.2 How do materials enter and leave a cell?
 - 7.2.1 The cell membrane
 - 7.2.1.1 Identify the two processes by which materials pass through the cell membrane
 - 7.2.1.2 Identify the structures in the cell membrane which regulate the passage of materials in and out of the cell
 - 7.2.1.3 Identify some of the colloidal particles which do not pass out of the cell
 - 7.2.1.4 Define permeable membrane
 - 7.2.1.5 Define semipermeable or differentially permeable membrane
 - 7.2.2 Passive transport - diffusion and osmosis
 - 7.2.2.1 Define diffusion
 - 7.2.2.2 Describe the importance of diffusion in maintaining an equilibrium in the cell
 - 7.2.2.3 Know two factors that affect the rate of diffusion in cells
 - 7.2.2.4 State the type of energy involved in diffusion
 - 7.2.2.5 Define osmosis
 - 7.2.2.6 Describe the relationship of diffusion and osmosis
 - 7.2.2.7 Define osmotic pressure
 - 7.2.2.8 Define hypotonic solution
 - 7.2.2.9 Describe what happens to cells in the hypotonic state
 - 7.2.2.10 Define hypertonic solution
 - 7.2.2.11 Describe what happens to cells in the hypertonic state
 - 7.2.2.12 Define isotonic solution
 - 7.2.2.13 Define turgid
 - 7.2.2.14 Describe the different effect of water intake in plant and animal cells
 - 7.2.2.15 Define plasmolysis
 - 7.2.2.16 Describe the way a plasmolyzed cell may be restored to its turgid condition
 - 7.2.3 Active transport
 - 7.2.3.1 Define active transport
 - 7.2.3.2 Identify the time when active transport occurs
- 7.3 Energy of foods made available for useful work
 - 7.3.1 Respiration
 - 7.3.1.1 Define respiration
 - 7.3.1.2 Define breathing
 - 7.3.1.3 Describe the importance of respiration in living things
 - 7.3.2 Chemical breakdown of glucose
 - 7.3.2.1 Describe the two distinct reactions in respiration

- 7.3.2.2 Define anaerobic respiration
- 7.3.2.3 Know the place in the cell where anaerobic respiration takes place
- 7.3.2.4 Describe what happens to glucose in the anaerobic process of respiration
- 7.3.2.5 Describe what happens to the energy in the anaerobic process
- 7.3.2.6 Define fermentation
- 7.3.2.7 Define aerobic respiration
- 7.3.2.8 Know the place where aerobic respiration takes place
- 7.3.2.9 Describe the importance of aerobic respiration

8.0 MAN IS A BIOLOGICAL ORGANISM

8.1 Food requirements for man

8.1.1 The nutrients

- 8.1.1.1 Define the term food
- 8.1.1.2 Name the type of energy that is stored in foods
- 8.1.1.3 Know the functions of foods in the body
- 8.1.1.4 Name the six classes of nutrients

8.1.2 Carbohydrates

- 8.1.2.1 Name the main carbohydrate foods
- 8.1.2.2 Know the function of carbohydrates
- 8.1.2.3 Name the elements in carbohydrates
- 8.1.2.4 List some foods that contain large amounts of carbohydrates
- 8.1.2.5 Describe the effect of excessive eating of carbohydrates
- 8.1.2.6 Describe the function of the celluloses in the body

8.1.3 Fats and oils

- 8.1.3.1 List some foods that contain large amounts of fats
- 8.1.3.2 Know the function of fats and oils in the body
- 8.1.3.3 Know the reason why people in cold countries eat large amounts of foods containing fats
- 8.1.3.4 Describe what happens to digested fats in the body
- 8.1.3.5 Describe the function of fatty acids and glycerol
- 8.1.3.6 Name the fat soluble vitamins
- 8.1.3.7 Define obesity
- 8.1.3.8 Describe how obesity can be avoided

8.1.4 Proteins

- 8.1.4.1 Define proteins
- 8.1.4.2 Know the function of proteins in the body
- 8.1.4.3 Name the essential element in all proteins
- 8.1.4.4 Describe the reason why children and adolescents need so much protein
- 8.1.4.5 Describe what happens to excess protein in the body
- 8.1.4.6 State the number of essential amino acids required by man
- 8.1.4.7 Name four foods that are rich in proteins

8.1.5 Vitamins

- 8.1.5.1 Know the function of vitamins in the body
- 8.1.5.2 Describe the type of compounds that vitamins represent
- 8.1.5.3 Define deficiency diseases
- 8.1.5.4 Describe what causes deficiency diseases
- 8.1.5.5 List some of the symptoms of scurvy
- 8.1.5.6 Name the vitamin that is lacking when an individual has scurvy
- 8.1.5.7 Describe the deficiency disease beriberi
- 8.1.5.8 Name the vitamin that is lacking in sufficient amounts when an individual has beriberi
- 8.1.5.9 Know the symptoms of beriberi
- 8.1.5.10 Know the different kinds of vitamins

8.1.6 Minerals

- 8.1.6.1 Describe the occurrence of minerals
- 8.1.6.2 Know the minerals needed by man in large amounts
- 8.1.6.3 Know the minerals needed by man in small amounts
- 8.1.6.4 List the most important minerals and their food source
- 8.1.6.5 Describe the way minerals exist in the body

8.1.7 Water

- 8.1.7.1 Describe the necessity for water in living things
- 8.1.7.2 Know the type of compound that water represents
- 8.1.7.3 Know what percent of the blood is water
- 8.1.7.4 Describe how water aids in digestion, and in metabolism
- 8.1.7.5 Define hydrolysis
- 8.1.7.6 Describe how water aids in the distribution and regulation of body heat
- 8.1.7.7 Know some sources of water for man
- 8.1.7.8 Know the average amount of water needed by a person per day

8.1.8 Calories

- 8.1.8.1 Define a calorie
- 8.1.8.2 Name some foods which are high in calorie content
- 8.1.8.3 Define basal metabolic rate
- 8.1.8.4 Know some factors that affect the basal metabolic rate in people
- 8.1.8.5 Describe the calorie needs for boys compared to girls
- 8.1.8.6 Describe what happens if a person does not get enough calories

- 8.1.8.7 Describe what happens if a person consumes too many calories
- 8.1.9 A balanced diet
 - 8.1.9.1 Define a "balanced diet"
 - 8.1.9.2 Know the importance of a balanced diet
 - 8.1.9.3 List the nine factors of good eating habits
- 8.2 How foods are digested
 - 8.2.1 Digestion
 - 8.2.1.1 Define digestion
 - 8.2.1.2 Identify the place where digestion takes place in man
 - 8.2.1.3 Know the organs of the alimentary canal
 - 8.2.2 The alimentary canal
 - 8.2.2.1 The mouth
 - 8.2.2.1.1 Describe the appearance and the relationship of the mouth's placement to the digestive tract
 - 8.2.2.1.2 Describe what happens to food in the mouth
 - 8.2.2.1.3 Know the number of sets of teeth man has during a lifetime
 - 8.2.2.1.4 Know the number of teeth a child has at the age of six to eight
 - 8.2.2.1.5 Define "milk teeth"
 - 8.2.2.1.6 Define "permanent teeth"
 - 8.2.2.1.7 Know the number of teeth an adult has
 - 8.2.2.1.8 Know the four types of teeth
 - 8.2.2.1.9 Describe the function of each type of tooth
 - 8.2.2.1.10 Define saliva
 - 8.2.2.1.11 Name the structures which secrete saliva
 - 8.2.2.1.12 List the three pairs of salivary glands
 - 8.2.2.1.13 Describe the location of each pair of salivary glands
 - 8.2.2.1.14 Name the enzyme found in saliva
 - 8.2.2.1.15 Describe how a bolus is formed and the purpose of its formation
 - 8.2.2.1.16 Know the amount of saliva produced daily
 - 8.2.2.2 The esophagus and pharynx
 - 8.2.2.2.1 Know the function of the pharynx
 - 8.2.2.2.2 Describe the esophagus and its function
 - 8.2.2.2.3 Describe the reason why food does not go into the trachea and esophagus at the same time
 - 8.2.2.2.4 Describe the function of the glottis
 - 8.2.2.2.5 Describe the epiglottis
 - 8.2.2.2.6 Describe what happens to the epiglottis during swallowing
 - 8.2.2.2.7 Give the length of the esophagus
 - 8.2.2.2.8 Define peristalsis
 - 8.2.2.3 The stomach
 - 8.2.2.3.1 Describe the shape of the stomach
 - 8.2.2.3.2 Describe the walls of the stomach
 - 8.2.2.3.3 Name the gastric juices produced by the gastric glands
 - 8.2.2.3.4 Name the substance that makes gastric juices acidic
 - 8.2.2.3.5 Name the thick substance that coats and protects the stomach lining
 - 8.2.2.3.6 Know the type of acid produced in the stomach
 - 8.2.2.3.7 Know the function of hydrochloric acid in the stomach
 - 8.2.2.3.8 Define pepsinogen
 - 8.2.2.3.9 Describe the action of pepsin in the stomach
 - 8.2.2.3.10 Know the function of the stomach
 - 8.2.2.3.11 Give the time limit that solid food remains in the stomach
 - 8.2.2.3.12 Describe what happens to the liquid foods
 - 8.2.2.3.13 Define chyme
 - 8.2.2.4 Small intestine
 - 8.2.2.4.1 Define duodenum and give its function
 - 8.2.2.4.2 Define secretin and give its function
 - 8.2.2.4.3 State the function of the hormone cholecystokinin.
 - 8.2.2.4.4 Describe the appearance of the small intestine
 - 8.2.2.4.5 Know the length of the small intestine
 - 8.2.2.4.6 Describe the movement of foods through the small intestine
 - 8.2.2.4.7 Name some pancreatic juices and their functions
 - 8.2.2.4.8 Define bile and name the place where it is stored and secreted
 - 8.2.2.4.9 Define villi
 - 8.2.2.4.10 Describe the location and function of the villi
 - 8.2.2.4.11 Identify the kind of food that is absorbed in the small intestine
 - 8.2.2.5 Large intestine
 - 8.2.2.5.1 Know the type of foods that enter into the large intestine
 - 8.2.2.5.2 Know the main function of the large intestine
 - 8.2.2.5.3 Describe the function of bacteria in the large intestine
 - 8.2.2.5.4 Name the two kinds of vitamins produced by the bacteria in the large intestine

- 7.3.2.2 Define anaerobic respiration
- 7.3.2.3 Know the place in the cell where anaerobic respiration takes place
- 7.3.2.4 Describe what happens to glucose in the anaerobic process of respiration
- 7.3.2.5 Describe what happens to the energy in the anaerobic process
- 7.3.2.6 Define fermentation
- 7.3.2.7 Define aerobic respiration
- 7.3.2.8 Know the place where aerobic respiration takes place
- 7.3.2.9 Describe the importance of aerobic respiration

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 - 8.1.5.4 Describe what causes deficiency diseases
 - 8.1.5.5 List some of the symptoms of scurvy
 - 8.1.5.6 Name the vitamin that is lacking when an individual has scurvy
 - 8.1.5.7 Describe the deficiency disease beriberi
 - 8.1.5.8 Name the vitamin that is lacking in sufficient amounts when an individual has beriberi
 - 8.1.5.9 Know the symptoms of beriberi
 - 8.1.5.10 Know the different kinds of vitamins
- 8.1.6 Minerals
 - 8.1.6.1 Describe the occurrence of minerals
 - 8.1.6.2 Know the minerals needed by man in large amounts
 - 8.1.6.3 Know the minerals needed by man in small amounts
 - 8.1.6.4 List the most important minerals and their food source
 - 8.1.6.5 Describe the way minerals exist in the body
- 8.1.7 Water
 - 8.1.7.1 Describe the necessity for water in living things
 - 8.1.7.2 Know the type of compound that water represents
 - 8.1.7.3 Know what percent of the blood is water
 - 8.1.7.4 Describe how water aids in digestion, and in metabolism
 - 8.1.7.5 Define hydrolysis
 - 8.1.7.6 Describe how water aids in the distribution and regulation of body heat
 - 8.1.7.7 Know some sources of water for man
 - 8.1.7.8 Know the average amount of water needed by a person per day
- 8.1.8 Calories
 - 8.1.8.1 Define a calorie
 - 8.1.8.2 Name some foods which are high in calorie content
 - 8.1.8.3 Define basal metabolic rate
 - 8.1.8.4 Know some factors that affect the basal metabolic rate in people
 - 8.1.8.5 Describe the calorie needs for boys compared to girls
 - 8.1.8.6 Describe what happens if a person does not get enough calories

- 8.1.8.7 Describe what happens if a person consumes too many calories
- 8.1.9 A balanced diet
 - 8.1.9.1 Define a "balanced diet"
 - 8.1.9.2 Know the importance of a balanced diet
 - 8.1.9.3 List the nine factors of good eating habits
- 8.2 How foods are digested
 - 8.2.1 Digestion
 - 8.2.1.1 Define digestion
 - 8.2.1.2 Identify the place where digestion takes place in man
 - 8.2.1.3 Know the organs of the alimentary canal
 - 8.2.2 The alimentary canal
 - 8.2.2.1 The mouth
 - 8.2.2.1.1 Describe the appearance and the relationship of the mouth's placement to the digestive tract
 - 8.2.2.1.2 Describe what happens to food in the mouth
 - 8.2.2.1.3 Know the number of sets of teeth man has during a lifetime
 - 8.2.2.1.4 Know the number of teeth a child has at the age of six to eight
 - 8.2.2.1.5 Define "milk teeth"
 - 8.2.2.1.6 Define "permanent teeth"
 - 8.2.2.1.7 Know the number of teeth an adult has
 - 8.2.2.1.8 Know the four types of teeth
 - 8.2.2.1.9 Describe the function of each type of tooth
 - 8.2.2.1.10 Define saliva
 - 8.2.2.1.11 Name the structures which secrete saliva
 - 8.2.2.1.12 List the three pairs of salivary glands
 - 8.2.2.1.13 Describe the location of each pair of salivary glands
 - 8.2.2.1.14 Name the enzyme found in saliva
 - 8.2.2.1.15 Describe how a bolus is formed and the purpose of its formation
 - 8.2.2.1.16 Know the amount of saliva produced daily
 - 8.2.2.2 The esophagus and pharynx
 - 8.2.2.2.1 Know the function of the pharynx
 - 8.2.2.2.2 Describe the esophagus and its function
 - 8.2.2.2.3 Describe the reason why food does not go into the trachea and esophagus at the same time
 - 8.2.2.2.4 Describe the function of the glottis
 - 8.2.2.2.5 Describe the epiglottis
 - 8.2.2.2.6 Describe what happens to the epiglottis during swallowing
 - 8.2.2.2.7 Give the length of the esophagus
 - 8.2.2.2.8 Define peristalsis
 - 8.2.2.3 The stomach
 - 8.2.2.3.1 Describe the shape of the stomach
 - 8.2.2.3.2 Describe the walls of the stomach
 - 8.2.2.3.3 Name the gastric juices produced by the gastric glands
 - 8.2.2.3.4 Name the substance that makes gastric juices acidic
 - 8.2.2.3.5 Name the thick substance that coats and protects the stomach lining
 - 8.2.2.3.6 Know the type of acid produced in the stomach
 - 8.2.2.3.7 Know the function of hydrochloric acid in the stomach
 - 8.2.2.3.8 Define pepsinogen
 - 8.2.2.3.9 Describe the action of pepsin in the stomach
 - 8.2.2.3.10 Know the function of the stomach
 - 8.2.2.3.11 Give the time limit that solid food remains in the stomach
 - 8.2.2.3.12 Describe what happens to the liquid foods
 - 8.2.2.3.13 Define chyme
 - 8.2.2.4 Small intestine
 - 8.2.2.4.1 Define duodenum and give its function
 - 8.2.2.4.2 Define secretin and give its function
 - 8.2.2.4.3 State the function of the hormone cholecystokinin.
 - 8.2.2.4.4 Describe the appearance of the small intestine
 - 8.2.2.4.5 Know the length of the small intestine
 - 8.2.2.4.6 Describe the movement of foods through the small intestine
 - 8.2.2.4.7 Name some pancreatic juices and their functions
 - 8.2.2.4.8 Define bile and name the place where it is stored and secreted
 - 8.2.2.4.9 Define villi
 - 8.2.2.4.10 Describe the location and function of the villi
 - 8.2.2.4.11 Identify the kind of food that is absorbed in the small intestine
 - 8.2.2.5 Large intestine
 - 8.2.2.5.1 Know the type of foods that enter into the large intestine
 - 8.2.2.5.2 Know the main function of the large intestine
 - 8.2.2.5.3 Describe the function of bacteria in the large intestine
 - 8.2.2.5.4 Name the two kinds of vitamins produced by the bacteria in the large intestine

- 8.2.2.5.5 Describe what happens to waste
- 8.3 Characteristics and functions of the circulatory system
- 8.3.1 Blood
- 8.3.1.1 Define blood
 - 8.3.1.2 Name some substances which are carried by the blood
 - 8.3.1.3 Name the organ that pumps the blood throughout the body
 - 8.3.1.4 Name the four major vessels that carry blood to and from the heart
 - 8.3.1.5 Know the volume of blood in the body of man
 - 8.3.1.6 Describe what is meant by whole blood
 - 8.3.1.7 Define hemoglobin and describe its function
 - 8.3.1.8 Define anemia and describe what happens when a person has anemia
 - 8.3.1.9 Name the places where the red corpuscles are formed
 - 8.3.1.10 Know the average life expectancy of the red blood cells
 - 8.3.1.11 Describe what happens to worn out red corpuscles
 - 8.3.1.12 Know another name used for red corpuscles
 - 8.3.1.13 Know the term used instead of white blood cells
 - 8.3.1.14 Compare the size and shape of the white blood cells with the red blood cells
 - 8.3.1.15 Compare the number of white blood cells with the number of red blood cells
 - 8.3.1.16 Know the function of the white blood cells
 - 8.3.1.17 Define phagocytes and describe their function
 - 8.3.1.18 Name the place where white blood cells are formed
 - 8.3.1.19 Describe the disease of leukemia
 - 8.3.1.20 Describe the blood platelets
 - 8.3.1.21 Know the function of the blood platelets
 - 8.3.1.22 Define plasma and describe its appearance
 - 8.3.1.23 Describe what percent of the plasma is water and what percent is other materials
 - 8.3.1.24 Name the digested food particles in the plasma
 - 8.3.1.25 Name the normal plasma proteins
 - 8.3.1.26 Describe the blood clotting process in the body
 - 8.3.1.27 Define hemophilia and describe the effects of hemophilia
 - 8.3.1.28 Describe the function of antibodies in the blood
 - 8.3.1.29 Know the gases in the plasma
 - 8.3.1.30 Know the most abundant mineral salt in the blood
- 8.3.2 Blood vessels
- 8.3.2.1 Name the three types of blood vessels
 - 8.3.2.2 Know the function of the arteries
 - 8.3.2.3 Describe the appearance of arteries
 - 8.3.2.4 Define pulse and describe what happens when you feel your pulse
 - 8.3.2.5 Define capillaries and describe capillaries
 - 8.3.2.6 Know the types of materials carried by the capillaries to the cell
 - 8.3.2.7 Define vein and describe veins
 - 8.3.2.8 Explain the purpose of valves in the veins
 - 8.3.2.9 Compare the size of veins with the size of arteries
- 8.3.3 The heart
- 8.3.3.1 Know the function of the heart
 - 8.3.3.2 Know the number of chambers in the human heart
 - 8.3.3.3 Describe the location of the heart in the human body
 - 8.3.3.4 Know the names of the upper chambers of the heart and their function
 - 8.3.3.5 Know the names of the lower chambers of the heart and their function
 - 8.3.3.6 Describe the circulation of blood through the heart
 - 8.3.3.7 Know the type of blood that is carried by the veins and arteries
 - 8.3.3.8 Explain the reason why the blood goes to the lungs from the heart
 - 8.3.3.9 Define systole and describe what happens during systolic movement or action
 - 8.3.3.10 Define diastole and describe what happens during diastolic movement or action
 - 8.3.3.11 Know the number of times the average heart beats per minute
 - 8.3.3.12 Know some things that may increase the heart beat
- 8.3.4 Blood groups
- 8.3.4.1 Give a reason for knowing your blood type
 - 8.3.4.2 Relate Karl Landsteiner's contribution to the discovery of blood groups
 - 8.3.4.3 Describe the way the blood type is acquired
 - 8.3.4.4 Name the four major blood types
 - 8.3.4.5 Describe what is meant by the universal recipient
 - 8.3.4.6 Describe what is meant by the universal donor
 - 8.3.4.7 Describe what happens when two samples of blood are mixed if the blood types are incompatible
 - 8.3.4.8 Describe the function of a blood bank
 - 8.3.4.9 Define "Rh factor"
 - 8.3.4.10 Know the two types of Rh factors
 - 8.3.4.11 Describe what is meant by Rh negative
 - 8.3.4.12 Describe what is meant by Rh positive
 - 8.3.4.13 Describe what happens if Rh negative blood is mixed with Rh positive blood

- 8.3.5 Circulation
 - 8.3.5.1 Relate William Harvey's contribution to blood circulation
 - 8.3.5.2 Name the two main systems into which the blood circulation is divided
 - 8.3.5.3 Know the function of the pulmonary system
 - 8.3.5.4 Describe the function of the systemic system
 - 8.3.5.5 Know the function of the portal circulation
 - 8.3.5.6 Name the organs involved in the portal circulation
 - 8.3.5.7 Describe the need for the blood to circulate
 - 8.3.5.8 Know the function of the lymph system
 - 8.3.5.9 Describe lymph and its components
 - 8.3.5.10 Describe the location of the lymph in the body
 - 8.3.5.11 Define lymphatics and describe the function of the lymphatics
 - 8.3.5.12 Define lacteals and describe the location and function of the lacteals
 - 8.3.5.13 Describe circulation and distribution of lymph throughout the body
- 8.4 Features of man's respiratory system
 - 8.4.1 The respiratory system
 - 8.4.1.1 Know the function of the respiratory system
 - 8.4.1.2 Define breathing
 - 8.4.1.3 Differentiate between respiration and breathing
 - 8.4.1.4 Know two phases of breathing
 - 8.4.1.5 State the normal number of inhalations and exhalations per minute
 - 8.4.1.6 Name the two principle components that are in the air we inhale and exhale
 - 8.4.1.7 Use a diagram to trace the air through the respiratory organs
 - 8.4.2 Oxygen
 - 8.4.2.1 Describe the process by which oxygen enters the blood stream from the lungs
 - 8.4.2.2 Define hemoglobin
 - 8.4.2.3 Describe the appearance of blood that is rich in oxyhemoglobin
 - 8.4.2.4 Explain the removal of carbon dioxide from the cells and other body parts
 - 8.4.3 Mechanics of breathing
 - 8.4.3.1 Know the function of the diaphragm in breathing
 - 8.4.3.2 Describe the structure and location of the diaphragm
 - 8.4.3.3 Explain the action of the diaphragm during breathing
 - 8.4.3.4 Describe some factors that determine the rate of breathing
 - 8.4.4 Lung capacity
 - 8.4.4.1 Know the amount of air a person would normally inhale and exhale at one time
 - 8.4.4.2 Know the maximum amount of air the lungs can hold
- 8.5 Removal of waste materials
 - 8.5.1 The skin
 - 8.5.1.1 Know the function of the excretory system
 - 8.5.1.2 Describe the function of the skin as an excretory organ
 - 8.5.1.3 Name the two major layers of the skin
 - 8.5.1.4 Name the layer of the skin where the sweat glands are located
 - 8.5.1.5 List the excretory organs and identify the function of each
 - 8.5.1.6 Define pore and describe the function of the pores in the skin
 - 8.5.1.7 Describe the function of perspiration
 - 8.5.1.8 Name some places where perspiration is more noticeable
 - 8.5.1.9 Describe how perspiration and other waste materials are formed
 - 8.5.1.10 Describe the importance of the sweat glands other than their excretory function
 - 8.5.2 Liver
 - 8.5.2.1 Describe the collection of waste materials in the liver
 - 8.5.2.2 Name the various waste materials formed in the liver
 - 8.5.2.3 Describe the size and appearance of the liver
 - 8.5.2.4 Name the organ used to eliminate Urea
 - 8.5.2.5 Define deamination
 - 8.5.2.6 Explain what happens when deamination occurs
 - 8.5.2.7 Describe the action of the liver on worn-out red blood cells
 - 8.5.3 Kidneys
 - 8.5.3.1 Know the location, size, and shape of the kidneys
 - 8.5.3.2 Know the function of the kidneys
 - 8.5.3.3 Name and describe the units that make up the kidneys
 - 8.5.3.4 Define urine and describe the components of urine
 - 8.5.3.5 State how much urine leaves the body each day
 - 8.5.4 Large intestine
 - 8.5.4.1 Know the location and shape of the large intestine
 - 8.5.4.2 Describe what type of waste is eliminated by the large intestine
 - 8.5.4.3 Describe the location of the appendix on the large intestine
 - 8.5.4.4 Name the organisms that live in the large intestine and their importance
 - 8.5.5 Lungs
 - 8.5.5.1 Name the two waste materials that are removed by the lungs from the body
 - 8.5.5.2 Describe a test for water vapor from the lungs
- 8.6 The characteristics and functions of the skeletal system
 - 8.6.1 The human skeleton
 - 8.6.1.1 Know three main functions of the skeleton

- 8.6.1.2 State the number of bones in the adult skeleton
- 8.6.1.3 Name the two main parts of the skeleton
- 8.6.1.4 Name the parts of the axial skeleton
- 8.6.1.5 Name the parts of the appendicular skeleton
- 8.6.1.6 Describe the composition of the living and non-living part of bones
- 8.6.1.7 Identify the three main parts of a bone
- 8.6.1.8 Describe the composition and function of cartilage
- 8.6.1.9 Name the two kinds of cartilage
- 8.6.1.10 Describe the difference between cartilage and bone
- 8.6.1.11 Name some places where cartilage is found in the body
- 8.6.2 Joints
 - 8.6.2.1 Define joint
 - 8.6.2.2 Name the seven types of joints in the body
 - 8.6.2.3 List one example of each type of joint
 - 8.6.2.4 Define bursa and identify its function
 - 8.6.2.5 Define synovial fluid and identify its function
 - 8.6.2.6 Define ligament and describe the function of ligaments
 - 8.6.2.7 Describe what happens when a ligament is injured
- 8.7 The characteristics and functions of the muscular system
 - 8.7.1 The muscles
 - 8.7.1.1 Know the function of the muscles
 - 8.7.1.2 Name the three kinds of muscle cells
 - 8.7.1.3 Define tendon and describe the function of tendons
 - 8.7.1.4 Name the two types of muscles according to type of movement produced
 - 8.7.1.5 Define the following terms: (1) belly, (2) origin, (3) muscle tone, and (4) insertion in relation to muscle tissue
 - 8.7.1.6 Differentiate between the function of a flexor and an extensor muscle
 - 8.7.1.7 Describe what is meant by muscle strain
 - 8.7.1.8 Give the names of some common arm and leg muscles in the human body

9.0 COORDINATION OF LIFE ACTIVITIES

- 9.1 Man's nervous system and control mechanisms
 - 9.1.1 The nervous system
 - 9.1.1.1 Know the combined functions of the nervous system
 - 9.1.1.2 Name the three main divisions of man's nervous system
 - 9.1.2 The parts of the nervous system
 - 9.1.2.1 Central nervous system
 - 9.1.2.1.1 Name the two parts of the central nervous system
 - 9.1.2.1.2 Know the function of the central nervous system
 - 9.1.2.1.3 Define cranium
 - 9.1.2.1.4 Name the structure that is located within the skull
 - 9.1.2.1.5 Know the main functions of the brain
 - 9.1.2.1.6 Describe the structure that houses the spinal cord
 - 9.1.2.1.7 Know the weight of an adult's brain
 - 9.1.2.1.8 Know the two types of matter that make up the brain
 - 9.1.2.1.9 Know the three most prominent parts of the brain
 - 9.1.2.2 The cerebrum
 - 9.1.2.2.1 Compare the size of the cerebrum with the other parts of the brain
 - 9.1.2.2.2 Know the type of activities that are interpreted by the cerebrum
 - 9.1.2.2.3 List some of the activities made possible by the cortex
 - 9.1.2.2.4 Know some activities controlled by the center of the brain
 - 9.1.2.3 Thalamus and hypothalamus
 - 9.1.2.3.1 Describe the location of the thalamus
 - 9.1.2.3.2 Describe the function of the thalamus
 - 9.1.2.3.3 Describe the location of the hypothalamus
 - 9.1.2.3.4 Know some of the important autonomic functions of the hypothalamus
 - 9.1.2.4 Midbrain
 - 9.1.2.4.1 Describe the location of the midbrain
 - 9.1.2.4.2 Know the activities that are associated with the midbrain
 - 9.1.2.5 The cerebellum
 - 9.1.2.5.1 Compare the size of the cerebellum with the other parts of the brain
 - 9.1.2.5.2 Describe the location of the cerebellum
 - 9.1.2.5.3 Know the main task of the cerebellum
 - 9.1.2.5.4 Describe what may happen if the cerebellum is injured
 - 9.1.2.6 The medulla
 - 9.1.2.6.1 Know the location and function of the medulla
 - 9.1.2.6.2 Describe some activities that are controlled by the medulla
 - 9.1.2.6.3 Describe the relationship between the vagus nerves and the medulla
 - 9.1.2.6.4 Know the activities that are controlled by the vagus nerves
 - 9.1.2.6.5 Explain what may happen if the medulla is injured

- 9.1.2.7 Spinal cord
 - 9.1.2.7.1 Describe the location of the spinal cord
 - 9.1.2.7.2 Describe the shape of the spinal cord
- 9.1.2.8 The peripheral nervous system
 - 9.1.2.8.1 Know the function of the peripheral nervous system
 - 9.1.2.8.2 Name the parts of the peripheral nervous system
 - 9.1.2.8.3 Define ganglion and describe the mechanics of the ganglion
 - 9.1.2.8.4 Name the two types of neurons
- 9.1.2.9 Autonomic nervous system
 - 9.1.2.9.1 Know the main function of the autonomic nervous system
 - 9.1.2.9.2 Name the various organs and glands that are controlled by the system
 - 9.1.2.9.3 List some of the involuntary acts that are controlled by the autonomic nervous system
 - 9.1.2.9.4 Name the two subsystems of the autonomic nervous system
 - 9.1.2.9.5 Describe the location of the cells that make up the sympathetic and parasympathetic systems
 - 9.1.2.9.6 Describe the function of the sympathetic and the parasympathetic systems
- 9.1.3 Features of the nervous control mechanism
 - 9.1.3.1 Describe the importance of responsiveness and irritability in relation to the nervous system
 - 9.1.3.2 Define responsiveness
 - 9.1.3.3 Define stimuli and list some examples of stimuli
 - 9.1.3.4 Know the three things that are involved in responsiveness
 - 9.1.3.5 Describe the relationship of the nervous system and the conducting, receiving, and responding to stimuli received
 - 9.1.3.6 Define effectors and their function
 - 9.1.3.7 Define neuron
 - 9.1.3.8 Identify the parts of a neuron
 - 9.1.3.9 Know the function of the following: (1) cell body, (2) dendrite, and (3) the axon
 - 9.1.3.10 Diagram the parts of a neuron
 - 9.1.3.11 Know the function of the myelin sheath
 - 9.1.3.12 Define and describe the action of the following: (1) sensory or afferent neurons, (2) motor or efferent neurons, and (3) association neurons
 - 9.1.3.13 Define synapse and explain how a synapse occurs
 - 9.1.3.14 Define reflex arc and reflex action
- 9.2 Man's sense organs
 - 9.2.1 Characteristics of the sense organs
 - 9.2.1.1 Know the function of the sense organs
 - 9.2.1.2 Define receptors and list the five known receptors of man
 - 9.2.1.3 Know the stimuli to which these receptors are sensitive
 - 9.2.2 The human eye
 - 9.2.2.1 Know the function of the eye
 - 9.2.2.2 Describe the structure and shape of the eye
 - 9.2.2.3 Diagram the eye and label its parts
 - 9.2.2.4 Know the function of each part of the eye
 - 9.2.2.5 Describe the process of seeing
 - 9.2.2.6 Describe the effect of the lack of vitamin A on the eye's proper functioning
 - 9.2.2.7 Identify the region where our most sharpest vision takes place
 - 9.2.2.8 Define blind spot
 - 9.2.2.9 Describe what is known as persistence of vision
 - 9.2.2.10 Describe what is meant by binocular vision
 - 9.2.2.11 List the three common kinds of eye defects
 - 9.2.2.12 Describe what causes farsightedness, nearsightedness, and astigmatism
 - 9.2.2.13 Describe the type of lens used to correct the eye defects of farsightedness, nearsightedness, and astigmatism
 - 9.2.2.14 List some simple things people can do to keep their eyes healthy
 - 9.2.3 The human ear
 - 9.2.3.1 Know the function of the ear
 - 9.2.3.2 Identify the three main parts of the ear
 - 9.2.3.3 Know the function of the outer ear
 - 9.2.3.4 Know the function of the middle ear
 - 9.2.3.5 Describe how sound waves are produced
 - 9.2.3.6 Describe the function of the auditory canal
 - 9.2.3.7 Describe what happens to the sound waves when they enter the middle ear
 - 9.2.3.8 Identify the three small bones in the middle ear
 - 9.2.3.9 Describe the function of the cochlea
 - 9.2.3.10 Describe the location and function of the organ of Corti
 - 9.2.3.11 Describe the location and function of the eustachian tube
 - 9.2.3.12 Describe what will happen if the air pressure on the eardrum is too great
 - 9.2.3.13 Identify the three structures located in the inner ear
 - 9.2.3.14 Describe the appearance and the function of the semicircular canals

- 9.2.3.15 Describe some changes that may occur if the fluid is not balanced in the canals
- 9.2.3.16 List some precautions which one should use in the care of the ears
- 9.2.3.17 Draw and label the parts of the ear
- 9.2.4 The senses of taste and smell
 - 9.2.4.1 Describe the relationship of the organs of taste and smell
 - 9.2.4.2 Describe the location and distribution of taste buds
 - 9.2.4.3 Know the four basic taste senses
 - 9.2.4.4 Identify the region on the tongue where each taste sensation occurs
 - 9.2.4.5 Discuss the ability to taste different substances by different people
 - 9.2.4.6 Name the receptor for smell in man
 - 9.2.4.7 Know the type of cells that make the ability to smell possible
 - 9.2.4.8 Describe how we can detect certain odors
- 9.2.5 The skin a sense organ
 - 9.2.5.1 Name the structures in the skin that control this sense organ
 - 9.2.5.2 Know the different stimuli to which the skin is sensitive
 - 9.2.5.3 Describe how we are able to feel certain sensations
- 9.3 Man's endocrine glands
 - 9.3.1 Characteristics of the endocrine system
 - 9.3.1.1 Know the function of the endocrine glands
 - 9.3.1.2 Explain why the endocrine glands are called ductless glands
 - 9.3.1.3 State the term used to describe the secretions of the endocrine glands
 - 9.3.1.4 Define hormone and describe the main function of hormones
 - 9.3.1.5 Name all of the endocrine glands in the human body
 - 9.3.2 Thyroid gland
 - 9.3.2.1 Describe the size and location of the thyroid gland
 - 9.3.2.2 Name the hormones produced by this gland
 - 9.3.2.3 Describe the importance of the thyroid hormones
 - 9.3.2.4 Explain the condition that occurs when there is deficiency in the thyroid hormones
 - 9.3.2.5 Differentiate between cretinism and myxedema
 - 9.3.2.6 Explain the condition that occurs when there is an over production of the thyroid hormones
 - 9.3.2.7 Define and describe what happens when a person has exophthalmia
 - 9.3.2.8 Describe what causes a goiter
 - 9.3.2.9 Discuss the ability of the thyroid gland to store iodine and its importance
 - 9.3.3 The parathyroid glands
 - 9.3.3.1 Describe the location of the parathyroid glands
 - 9.3.3.2 Name the hormone produced by the parathyroids
 - 9.3.3.3 Know the function of the parathyroid hormone
 - 9.3.3.4 Describe what happens if there is a deficiency of parathormone
 - 9.3.3.5 Describe what happens if there is an increased amount of the parathyroid hormone
 - 9.3.4 The adrenal glands
 - 9.3.4.1 Describe the location of the adrenal glands
 - 9.3.4.2 Describe the structure and function of the adrenal glands
 - 9.3.4.3 Give the names of the outer and inner parts of the adrenal glands
 - 9.3.4.4 Name the two hormones produced by the medulla
 - 9.3.4.5 Describe the action and other function of these hormones produced by the medulla
 - 9.3.4.6 Describe how adrenalin affects the body
 - 9.3.4.7 Give the number of hormones produced by the adrenal cortex
 - 9.3.4.8 Know the function of the adrenal cortex hormones on the body
 - 9.3.4.9 Describe what happens if the adrenal cortex is removed from the body
 - 9.3.4.10 Describe what happens if there is a malfunction of the adrenal cortex
 - 9.3.4.11 Describe how cortisone is used by physicians in the treatment of arthritis or rheumatism
 - 9.3.5 The pituitary glands (hypophysis)
 - 9.3.5.1 Compare the size of the pituitary gland with the other endocrine glands
 - 9.3.5.2 Give the location of the pituitary glands
 - 9.3.5.3 Describe the reason for this gland being called the "master gland"
 - 9.3.5.4 Give the names of the two lobes of the pituitary gland
 - 9.3.5.5 Give the name of one of the hormones produced by the pituitary gland
 - 9.3.5.6 Describe what happens if there is a deficiency in the growth hormone in childhood
 - 9.3.5.7 Describe what will happen if there is overproduction of the growth hormone
 - 9.3.5.8 Know the function of the hormone thyrotropic
 - 9.3.5.9 Define ACTH and identify the function of the hormone known as ACTH
 - 9.3.5.10 Name the two hormones produced by the posterior lobe of the pituitary gland
 - 9.3.5.11 Describe the function of the hormone vasopressin
 - 9.3.5.12 Describe what happens if there is an undersecretion of vasopressin
 - 9.3.5.13 Describe the function of the hormone oxytocin
 - 9.3.6 Pancreas
 - 9.3.6.1 Describe the location of the pancreas

- 9.3.6.2 Explain why the pancreas is both a duct and ductless gland
- 9.3.6.3 Name the structures in the pancreas that help to classify it as a ductless gland
- 9.3.6.4 Name the chemical that the "Islets of Langerhans" secrete
- 9.3.6.5 Describe the important role of insulin
- 9.3.6.6 Explain what happens if the pancreas fails to produce insulin
- 9.3.6.7 Describe what can be done if diabetes is caused by failure of the gland to secrete insulin
- 9.3.6.8 Explain the importance of having a medical examination to detect diabetes
- 9.3.6.9 Explain what may happen if there is too much insulin in the blood
- 9.3.7 Hormones of some other glands and organs
 - 9.3.7.1 Name the hormones secreted by the male sex organs
 - 9.3.7.2 Describe how these hormones affect males during adolescence
 - 9.3.7.3 Name the hormones secreted by the female reproductive organs
 - 9.3.7.4 Describe how these hormones affect females during adolescence
 - 9.3.7.5 Name the organs that produce or secrete hormones in other parts of the body
- 9.4 Plant hormones
 - 9.4.1 Auxins
 - 9.4.1.1 Know the function of plant hormones
 - 9.4.1.2 Know the places in the plant that are capable of producing or synthesizing hormones
 - 9.4.1.3 Describe the influence of auxins on plants
 - 9.4.1.4 Describe the affect of auxins on the development of roots, leaves, buds, and flowers
 - 9.4.2 Gibberellins
 - 9.4.2.1 Know the types of plants in which gibberellins are found
 - 9.4.2.2 Explain how the gibberellin hormone affects the plant
 - 9.4.2.3 Explain why gibberellin is sometimes applied to biennial plants
 - 9.4.3 Flowering
 - 9.4.3.1 Name the hormone that is believed to control flowering
 - 9.4.3.2 Describe what seems to be the most significant factor in flowering
 - 9.4.3.3 Name the three types of flowering plants according to the length of day
 - 9.4.3.4 Define photoperiodism
 - 9.4.3.5 Describe the flowering of short-day plants and list five examples
 - 9.4.3.6 Describe the flowering of long-day plants and list five examples
 - 9.4.3.7 Describe day-neutral plants and list five examples
- 9.5 Factors of human behavior
 - 9.5.1 Reflexes
 - 9.5.1.1 Define simple reflex and list some examples of simple reflexes
 - 9.5.1.2 Illustrate a simple reflex
 - 9.5.1.3 Define conditioned reflexes
 - 9.5.1.4 Relate Pavlov's work and its relationship to the study of conditioned reflexes
 - 9.5.1.5 Define conditioning
 - 9.5.1.6 Describe what is meant by "learned behavior"
 - 9.5.2 Habits
 - 9.5.2.1 Define habit and list three examples of habits
 - 9.5.2.2 Define facilitation
 - 9.5.2.3 List some reasons for forming habits
 - 9.5.2.4 Know some factors in forming and breaking of habits
 - 9.5.2.5 List some undesirable habits and compare them with desirable habits
 - 9.5.3 Emotions
 - 9.5.3.1 Define emotions and describe their occurrence
 - 9.5.3.2 List five emotional factors that affect behavior
 - 9.5.3.3 Describe some effects of emotional stresses

10.0 LIFE CONTINUES FROM ONE GENERATION TO ANOTHER

- 10.1 Features of cell division
 - 10.1.1 Cell division - growth
 - 10.1.1.1 State the two ways living things grow
 - 10.1.1.2 List some examples of cells increasing in size
 - 10.1.1.3 Describe how cell division acts as means of growth in multicellular organisms
 - 10.1.2 Cell division - reproduction
 - 10.1.2.1 Explain how cell division is a means of reproduction in multicellular organisms
 - 10.1.2.2 Name the type of cell division in one celled animals
 - 10.1.2.3 Define mitosis
 - 10.1.3 Cells - chromosomes
 - 10.1.3.1 Describe the location of the chromosomes in the cell
 - 10.1.3.2 Know the chemical substance of chromosomes and the function of this substance in the chromosomes
 - 10.1.3.3 Define genes and describe their location in relation to chromosomes
 - 10.1.3.4 Know the number of chromosomes found in the nucleus of each of man's body cells

- 10.1.3.5 Relate the fact that chromosomes function in pairs
- 10.1.4 Cell division (mitosis)
 - 10.1.4.1 Relate the idea that the nucleus divides before the rest of the cell
 - 10.1.4.2 List the phases of mitosis
 - 10.1.4.3 Draw a diagram of each phase and tell what happens in each phase of mitosis
 - 10.1.4.4 Describe the significance of cell division
- 10.2 How new organisms are produced
 - 10.2.1 Vegetative or asexual reproduction
 - 10.2.1.1 Describe the four basic features of asexual reproduction
 - 10.2.1.2 Define "daughter cells" and explain how they are formed
 - 10.2.1.3 Define fission and list some examples of organisms that reproduce by fission
 - 10.2.1.4 Describe the process of reproduction in yeast cells
 - 10.2.1.5 Define spores and list some plants that reproduce by spores
 - 10.2.1.6 Name some other vegetative structures in plants that illustrate asexual reproduction
 - 10.2.1.7 Define regeneration and name some organisms that are capable of regenerating
 - 10.2.1.8 Define parthenogenesis and name some organisms that develop their eggs in this manner
 - 10.2.1.9 Relate the fact that asexual reproduction provides little or no change in the offspring from the parent
 - 10.2.2 Sexual reproduction
 - 10.2.2.1 Define reproduction
 - 10.2.2.2 Define gametes and name the two kinds of gametes in sexual reproduction
 - 10.2.2.3 Define fertilization
 - 10.2.2.4 Define zygote
 - 10.2.2.5 Describe what happens to the zygote following fertilization
 - 10.2.3 Formation of reproductive cells - meiosis
 - 10.2.3.1 Define meiosis
 - 10.2.3.2 Describe the difference between meiosis and mitosis
 - 10.2.3.3 Describe what happens in the first and second meiotic divisions
 - 10.2.3.4 Explain the development of diploid and haploid numbers
 - 10.2.3.5 Draw a diagram illustrating the divisions of meiosis
 - 10.2.4 Fertilization and the development of the zygote
 - 10.2.4.1 Describe how fertilization reestablishes the diploid number
 - 10.2.4.2 Describe the process of cleavage
 - 10.2.4.3 Describe the development of the blastula and gastrula
 - 10.2.4.4 Give the number and names of the membranes that function in the development of an embryo
 - 10.2.4.5 Give the gestation period in man and other mammals
- 10.3 How characteristics are passed from one generation to another
 - 10.3.1 Mendel's experiment with garden peas
 - 10.3.1.1 Relate Gregor Mendel's contribution to the study of heredity
 - 10.3.1.2 Define heredity and name some characteristics that may be transferred from one generation to the next
 - 10.3.1.3 Describe the procedures used by Mendel to study inherited traits
 - 10.3.1.4 Define and describe what is meant by dominant and recessive factors
 - 10.3.2 Genes and chromosomes in inheritance
 - 10.3.2.1 Define gene and know the function of the genes
 - 10.3.2.2 Describe the relationship between DNA and the gene
 - 10.3.2.3 Relate the fact that genes and chromosomes exist in pairs
 - 10.3.2.4 Define homologous chromosomes
 - 10.3.2.5 Describe the difference between homozygous and heterozygous traits
 - 10.3.2.6 Define hybrid and describe how a hybrid offspring is produced
 - 10.3.2.7 Illustrate an example of a test-cross
 - 10.3.2.8 Describe the difference between a hybrid and a dihybrid
 - 10.3.3 Gene interaction and other relationships
 - 10.3.3.1 Define incomplete dominance
 - 10.3.3.2 Define complementary genes
 - 10.3.3.3 Define multiple gene
 - 10.3.3.4 Define lethal genes
 - 10.3.4 Sex determination and sex-linked chromosomes
 - 10.3.4.1 Name the two sex chromosomes
 - 10.3.4.2 Differentiate between the male and female sex chromosome
 - 10.3.4.3 Define hemophilia
 - 10.3.4.4 Describe the reason why hemophilia is a disease in men only
 - 10.3.4.5 Describe why some men are color blind
 - 10.3.5 Gene change - mutation
 - 10.3.5.1 Define mutation
 - 10.3.5.2 Name the organism that has been used to study mutations
 - 10.3.5.3 Relate Herman Muller's contribution to the study of mutations by the use of X-rays and other types of rays
 - 10.3.5.4 Explain the effect of mutations on living things
 - 10.3.5.5 Define point mutations

- 10.3.5.6 Describe the relationship between mutations and natural selection
- 10.3.5.7 Describe how some mutations are helpful to man

11.0 SCIENTIFIC CONTRIBUTIONS TO MAN'S HEALTH

11.1 The study of diseases

11.1.1 Early ideas and studies

- 11.1.1.1 Relate Louis Pasteur's theory and Robert Koch's experiments that established the germ theory of disease
- 11.1.1.2 Relate Joseph Lister's idea of sterilizing instruments to be used in surgery
- 11.1.1.3 Name the person who invented a vaccine for rabies and anthrax
- 11.1.1.4 Name the person who produced effective vaccines against polio infections
- 11.1.1.5 Relate Karl Landsteiner's work with blood transfusions
- 11.1.1.6 Name the person who discovered insulin
- 11.1.1.7 Relate Alexander Fleming's contribution to the control of diseases
- 11.1.1.8 Name the "father of medicine"

11.1.2 Kinds of diseases

- 11.1.2.1 Name the two general classes of diseases
- 11.1.2.2 Define infection and describe how infectious diseases are contracted
- 11.1.2.3 Define "pathogenic agents"
- 11.1.2.4 Name several kinds of noninfectious diseases
- 11.1.2.5 Define "organic diseases"
- 11.1.2.6 Describe "degenerative diseases"
- 11.1.2.7 Define allergies
- 11.1.2.8 Describe the difference between an acute and chronic disease

11.1.3 Spread of diseases

- 11.1.3.1 Name the two classes of infectious diseases
- 11.1.3.2 Describe how infectious diseases occur
- 11.1.3.3 Describe how infectious disease carrying microorganisms enter the body
- 11.1.3.4 Define "incubation period"
- 11.1.3.5 Define and describe the effect each of the following has on the body: (1) toxins, (2) exotoxins, and (3) endotoxins
- 11.1.3.6 Describe what is meant by the term carrier

11.1.4 Diseases caused by bacteria and viruses

- 11.1.4.1 Know the type of bacteria that causes diseases
- 11.1.4.2 List ten examples of diseases caused by pathogenic bacteria
- 11.1.4.3 Know some of the ways bacterial diseases are transmitted and how they enter the body
- 11.1.4.4 Describe how bacteria cause food poisoning or botulism
- 11.1.4.5 Describe what happens when viruses enter the body
- 11.1.4.6 Describe the use of vaccines in the establishing immunity against virus diseases

11.1.5 Diseases caused by protists, molds, rickettsiae, and worms

- 11.1.5.1 Describe how the disease carrying protists enter the body
- 11.1.5.2 List five diseases that are caused by certain protists
- 11.1.5.3 Describe how mold diseases are transmitted
- 11.1.5.4 Describe the habitat of the rickettsiae
- 11.1.5.5 Describe how the rickettsiae are transmitted to other organisms
- 11.1.5.6 Describe some preventive methods that can be used to control the carriers of the rickettsiae

11.2 Some conditions that help prevent and control diseases

11.2.1 Body defenses

- 11.2.1.1 Describe the three lines of defenses against diseases
- 11.2.1.2 Describe the importance of the skin as a line of defense against diseases
- 11.2.1.3 Describe the function of mucus and tears
- 11.2.1.4 Define antigens

11.2.2 Immunity

- 11.2.2.1 Define the term immunity
- 11.2.2.2 Describe what is meant by the statement "immune to a disease"
- 11.2.2.3 Define the term susceptible
- 11.2.2.4 Describe what is meant by natural immunity
- 11.2.2.5 Name some of the diseases that man does not have natural immunity against
- 11.2.2.6 Define the term "acquired immunity"
- 11.2.2.7 Describe the two types of acquired immunity
- 11.2.2.8 Define "active immunity" and describe how it is attained
- 11.2.2.9 List some diseases that are associated with active immunity
- 11.2.2.10 Define "passive immunity" and describe how it is attained

11.3 Conditions that contribute to maintaining a healthy body

11.3.1 Rest and sleep

- 11.3.1.1 Describe the symptoms of failure to get the proper amount of rest and sleep
- 11.3.1.2 State the amount of sleep an individual should get daily

11.3.2 Exercise

- 11.3.2.1 Explain the need for proper exercise

- 11.3.2.2 Give some of the benefits of being physically fit
- 11.3.2.3 List some exercises that help keep the body in "good" condition
- 11.3.3 Good posture
 - 11.3.3.1 List some bad effects of poor posture
 - 11.3.3.2 Describe some ways in which poor posture may develop
 - 11.3.3.3 Describe how good posture is characterized
 - 11.3.3.4 Describe the position of certain body parts that exhibit good posture.
- 11.3.4 Personal cleanliness
 - 11.3.4.1 List some of the desirable reasons for personal cleanliness
 - 11.3.4.2 Discuss some of the reasons why pimples and blackheads should not be squeezed
 - 11.3.4.3 Define acne and describe some practices that are both preventive and treatment in nature
- 11.3.5 Dangerous drugs, tobacco, and alcohol
 - 11.3.5.1 List some drugs that are classified as narcotics
 - 11.3.5.2 Name the most dangerous of the narcotics
 - 11.3.5.3 Name some drugs that are classified as barbiturates
 - 11.3.5.4 Describe the effects of those drugs classified as stimulants
 - 11.3.5.5 List some of the dangers of using marijuana
 - 11.3.5.6 Discuss some of the federal, state, and local laws that have been passed prohibiting any activities concerned with buying, selling, or using narcotics except those prescribed by a physician
 - 11.3.5.7 Give some reasons why people smoke
 - 11.3.5.8 Name some diseases associated with smoking
 - 11.3.5.9 Describe some of the most common side effects of smoking
 - 11.3.5.10 Describe some of the harmful effects produced by alcohol
 - 11.3.5.11 Explain why a person should not drink and drive
- 11.3.6 Mental Health
 - 11.3.6.1 Describe some of the problems associated with poor mental health
 - 11.3.6.2 Describe the importance of establishing good mental habits
 - 11.3.6.3 List three characteristic activities that will help to form better mental health habits
- 11.4 How can the knowledge and the practice of safety conserve life?
 - 11.4.1 Causes of accidents
 - 11.4.1.1 Explain the fact that accidents are caused and do not just happen
 - 11.4.1.2 List some of the things that lead to accidents
 - 11.4.1.3 Name the major factor that accounts for almost half of all fatal accidents
 - 11.4.2 Accidents in the home
 - 11.4.2.1 Give the percent of all accidents that occur in the home
 - 11.4.2.2 List some preventive measures for prevention of home accidents
 - 11.4.2.3 List some ways to prevent fire in the home
 - 11.4.2.4 Describe how scalds and burns can be prevented
 - 11.4.2.5 Discuss the necessity for gun safety in the home
 - 11.4.2.6 Discuss the ways to prevent asphyxiation
 - 11.4.3 Swimming and boating safety
 - 11.4.3.1 Give the percent of fatalities caused by drownings
 - 11.4.3.2 List the nine safety rules to observe in water or around water
 - 11.4.4 First aid
 - 11.4.4.1 Describe what should be done in case of a serious accident
 - 11.4.4.2 Describe what should be done in the case of great loss of blood and/or to prevent great loss of blood
 - 11.4.4.3 Name the location of the pressure points in the body to stop bleeding
 - 11.4.4.4 Describe what should be done in the case of breath stoppage
 - 11.4.4.5 Give some of the effects of breath shortage
 - 11.4.4.6 Discuss the cause of fainting
 - 11.4.4.7 Describe what should be done in the case of fainting
 - 11.4.4.8 Describe the causes of shock
 - 11.4.4.9 List some indications of shock
 - 11.4.4.10 Describe what should be done if a person is in shock
 - 11.4.4.11 Describe the three types of burns
 - 11.4.4.12 Describe what should be done in each case of burns
 - 11.4.4.13 State what should be done in cases of minor cuts or puncture wounds
 - 11.4.4.14 Describe what should and should not be done if a person has broken bone
 - 11.4.4.15 Describe the immediate action needed in the case of poisoning
 - 11.4.4.16 Describe how to look for or give antidotes in cases of poisoning
 - 11.4.4.17 Describe certain antidotes that may be used in case of poisoning

12.0 MANIPULATION OF SKILLS

- 12.1 The microscope
 - 12.1.1 Practical techniques
 - 12.1.1.1 Describe the techniques of preparing a slide with a cover slip
 - 12.1.1.2 Describe the technique of placing the slide on the stage of the microscope
 - 12.1.1.3 Know the location and function of each of the microscope parts

- 12.1.1.4 Describe the technique of adjusting the light source for microscopic observations
- 12.1.1.5 Describe the steps in focusing the microscope with the coarse and fine adjustment knobs
- 12.1.1.6 Describe the use of the coarse adjustment knob with the low power objective
- 12.1.1.7 Describe the use of the fine adjustment knob with the low and high power objectives
- 12.1.1.8 Compute the total magnification of a compound microscope
- 12.1.1.9 Sketch a three dimension view of a typical onion cell with the aid of a microscope
- 12.1.1.10 Estimate within $\pm 50\%$ the number of colonies per cm^2 on a teacher prepared slide
- 12.1.1.11 Prepare a wet mount specimen slide with a cover slip
- 12.2 Metric measurement
 - 12.2.1 Temperature
 - 12.2.1.1 Locate the 0° and 100° references on the Celsius scale
 - 12.2.1.2 Locate the 32° and 212° references on the Fahrenheit scale
 - 12.2.1.3 Know the temperature at which certain substances boil and freeze
 - 12.2.2 Other metric terms
 - 12.2.2.1 Define and list the metric length units
 - 12.2.2.2 Compute problems using the metric value to change various English measurements
 - 12.2.2.3 Define and list the metric surface units
 - 12.2.2.4 Compute problems using the metric value to change various English measurements
 - 12.2.2.5 List the metric weight units
 - 12.2.2.6 Measure some substances and compute their English and metric weights
- 12.3 Burners
 - 12.3.1 Mechanics of burners
 - 12.3.1.1 Light and adjust the fuel and air for an acceptable flame
 - 12.3.1.2 List proper corrective adjustments for a yellow, red, and carbon deposit flame
 - 12.3.1.3 Describe the location of the red, yellow, and blue flame
- 12.4 Stains
 - 12.4.1 Selection of stains
 - 12.4.1.1 Know the type of stain used to study the following: starch in onion cells, red and white blood cells, nuclei, and lipids
 - 12.4.1.2 Prepare a slide using the appropriate stain for the appropriate cell type
 - 12.4.1.3 Sketch a microscopic view of the above before and after staining
- 12.5 Indicators
 - 12.5.1 Selection of indicators
 - 12.5.1.1 Name the indicator used for testing the presence of the following: (1) starch, (2) simple sugars, (3) proteins, (4) fats, (5) acids and bases, and (6) CO_2
 - 12.5.1.2 Prepare a test using the appropriate indicator for the above
 - 12.5.1.3 Indicate the color which proves the presence of a certain substance
- 12.6 Graphs
 - 12.6.1 Construction of graphs
 - 12.6.1.1 Construct a graph using two variables from a data table
 - 12.6.1.2 Describe limitations, errors, and improper use of graphs
- 12.7 Dissection
 - 12.7.1 Dissection of live and preserved specimens
 - 12.7.1.1 Prepare a cross section of an earthworm or small stems of local plants
 - 12.7.1.2 Prepare a longitudinal section of an earthworm or small stem of a local plant
 - 12.7.1.3 Locate, sketch, and trace structures and/or systems in dissected specimens

GENERAL SCIENCE

LEVEL 8

1.0 THE NATURE OF LIFE

- 1.1 List five processes of living things
- 1.2 Cellular organization
 - 1.2.1 Describe the function of the cell nucleus, cell membrane, and cytoplasm
 - 1.2.2 Prepare a slide for viewing under the microscope
- 1.3 Energy and life processes
 - 1.3.1 Name four forms of matter
 - 1.3.2 Explain the process by which energy is obtained from matter by living things
 - 1.3.3 Describe the transfer of energy from food to tissues in living things

2.0 DIVERSITY OF LIFE

- 2.1 Protista
 - 2.1.1 Name the three basic shapes of bacteria
 - 2.1.2 Name three beneficial and three harmful bacteria
- 2.2 Plants
 - 2.2.1 Plants without chlorophyll
 - 2.2.1.1 List three ways plants without chlorophyll obtain their food
 - 2.2.1.2 Describe two kinds of relationships exhibited by chlorophyllless plants with other organisms
 - 2.2.1.3 Distinguish between harmful and beneficial plants lacking chlorophyll
 - 2.2.2 Simple green plants
 - 2.2.2.1 Name three habitats that contain simple green plants
 - 2.2.2.2 Give the role of the simple green plants in the food pyramid
 - 2.2.2.3 Describe why the simple green plants are considered "producers"
 - 2.2.3 Vascular green plants
 - 2.2.3.1 Spore bearing plants
 - 2.2.3.1.1 Explain how spore bearing green plants carry on three life processes
 - 2.2.3.1.2 Describe the spore formation and "scattering" in one example of a green plant
 - 2.2.3.2 Nonwoody seed plants
 - 2.2.3.2.1 Trace the transportation of food, water, and nutrients through a "weed"
 - 2.2.3.2.2 Describe the usual life cycle of nonwoody seed plants
 - 2.2.3.2.3 Give the distinguishing characteristics of nonwoody seed plants
 - 2.2.3.3 Woody seed plants
 - 2.2.3.3.1 Determine the age of a tree by the annual rings
 - 2.2.3.3.2 Identify broad-leaved trees and coniferous trees
 - 2.2.3.3.3 Explain how tall trees, heights above 30 feet, transport water, nutrients and food
 - 2.2.3.3.4 Give five ways trees are used by man
- 2.3 Animals
 - 2.3.1 Lower invertebrates
 - 2.3.1.1 Name two major characteristics of sponges, colenterates, flatworms, and roundworms
 - 2.3.1.2 List three ways in which simple worms are beneficial and three ways in which simple worms are harmful to man
 - 2.3.1.3 Describe two life processes for sponges, hydra, tapeworms, and hookworms
 - 2.3.2 Higher invertebrates
 - 2.3.2.1 Name two major characteristics of mollusks, annelids, arthropods, and echinoderms
 - 2.3.2.2 Describe two life processes of clams, earthworms, and starfish
 - 2.3.2.3 List one advantage and one disadvantage of an exoskeleton
 - 2.3.3 Vertebrates
 - 2.3.3.1 Fish
 - 2.3.3.1.1 Name three examples of bony fish
 - 2.3.3.1.2 Describe the body coverings of fish
 - 2.3.3.1.3 Explain how fish reproduce
 - 2.3.3.1.4 Relate the temperature of a fish to the temperature of the water in which the fish is found
 - 2.3.3.2 Amphibians
 - 2.3.3.2.1 Describe three different groups of amphibians
 - 2.3.3.2.2 Distinguish between frogs and toads
 - 2.3.3.2.3 Explain the life cycle of a typical amphibian (the grass frog)
 - 2.3.3.2.4 Define the terms: hibernation, estivation, and migration
 - 2.3.3.3 Reptiles
 - 2.3.3.3.1 Name three groups of reptiles
 - 2.3.3.3.2 Explain how reptiles reproduce
 - 2.3.3.3.3 "Reptiles are cold-blooded"--explain the significance of this statement
 - 2.3.3.4 Birds
 - 2.3.3.4.1 Name five special adaptation of birds

- 2.3.3.4.2 Explain the fact that birds have high metabolic rates
- 2.3.3.4.3 Name three groups of birds according to feeding habits
- 2.3.3.4.4 Relate the care of baby birds to the time required for incubation
- 2.3.3.4.5 List five ways birds are considered beneficial to man
- 2.3.3.5 Mammals
 - 2.3.3.5.1 Name an example of each order of mammal
 - 2.3.3.5.2 Describe the life processes of two representative orders of mammals (exclude man)
 - 2.3.3.5.3 Man
 - 2.3.3.5.3.1 Name the parts of the respiratory system
 - 2.3.3.5.3.2 Describe six good health practices as relates to the respiratory system
 - 2.3.3.5.3.3 Explain how food is transformed into soluble materials ready to be absorbed into the blood system of man
 - 2.3.3.5.3.4 List the sites for digestion of various classes of foods
 - 2.3.3.5.3.5 Define white blood cells, red blood cells, and plasma
 - 2.3.3.5.3.6 Trace the general pattern of blood flow through man's body
 - 2.3.3.5.3.7 Describe how waste is removed from the body of man
 - 2.3.3.5.3.8 List the advantages of having an endoskeleton
 - 2.3.3.5.3.9 Locate four main types of joints
 - 2.3.3.5.3.10 Name three functions of the nervous system of man
 - 2.3.3.5.3.11 Relate the secretion of hormones to the body activities of man
 - 2.3.3.5.3.12 Differentiate among infectious diseases, glandular diseases, and organic diseases

3.0 RELATIONSHIPS OF LIFE

- 3.1 Draw three "three-link" food chains
- 3.2 Describe two predator-prey relationships
- 3.3 Distinguish between producers and consumers
- 3.4 Relate populations to communities
- 3.5 Explain how man "fits" into the web-of-life
- 3.6 Relate water, air, and soil to life

4.0 THE EARTH

- 4.1 Lithosphere
 - 4.1.1 Crust
 - 4.1.1.1 Describe the four types of seismic waves
 - 4.1.1.2 Trace the movement of water resulting in geysers, springs, lakes, ponds, streams, and artesian wells
 - 4.1.1.3 Explain the formation of intrusive and extrusive rocks
 - 4.1.1.4 Give the features of sedimentary rocks
 - 4.1.1.5 Explain the carbon-14 dating method
 - 4.1.1.6 Define the term paleontology
 - 4.1.1.7 Compare foliated and unfoliated processes
 - 4.1.1.8 Illustrate the processes of rocks being formed by each foliated and unfoliated methods
 - 4.1.1.9 Know the significance of specific gravity, hardness, shape, luster, color, bead test, and flame test as they relate to the classification of minerals
 - 4.1.1.10 Understand the economic importance of minerals and rocks to man
- 4.2 Hydrosphere
 - 4.2.1 Know the general composition of ocean water
 - 4.2.2 Name and locate the major oceans of the world
 - 4.2.3 Describe the physical features of the ocean floor
 - 4.2.4 Explain how ocean movement affects the land structures, volcanic action, and earthquakes
 - 4.2.5 Explain why rivers flow in particular directions
 - 4.2.6 Trace the Mississippi river system labeling the head, mouth, and major tributaries
- 4.3 Atmosphere
 - 4.3.1 Explain why clouds are formed only in the troposphere
 - 4.3.2 Describe the causes of wind
 - 4.3.3 Define the following terms: meteorology, humidity, barometric pressure, and dew point
 - 4.3.4 Explain the use of the thermometer, barometer, hygrometer, wind vane, anemometer, and weather satellite
 - 4.3.5 Relate the correlation between altitude and temperature

- 4.3.6 Relate the correlation between altitude and barometric pressure
- 4.3.7 Explain the formation of ions in the ionosphere
- 4.3.8 Relate the ionosphere to the transmission of radio waves

5.0 THE SOLAR SYSTEM

5.1 Planets

- 5.1.1 Define the term astronomical unit
- 5.1.2 Name the planets having natural satellites
- 5.1.3 Compare the gravity of the moon with that of the earth
- 5.1.4 Explain the relationship of the moon to tides on earth
- 5.1.5 Gravitation
 - 5.1.5.1 Relate the effects of "g's" on space travel
 - 5.1.5.2 Explain the relationship between mass and inertia
 - 5.1.5.3 Know the escape velocity of an object from the earth's gravitational field

5.2 Other bodies and particles

- 5.2.1 Trace the path of Halley's comet
- 5.2.2 Describe the composition of a comet
- 5.2.3 Know the origin of cosmic rays
- 5.2.4 Distinguish between primary and secondary cosmic rays

5.3 Man and instruments - astronomy

- 5.3.1 Know the significant discoveries of: Fraunhofer, Kepler, Copernicus, Ptolemy, Brahe, Galileo, and Newton as relates to astronomy
- 5.3.2 Know the uses of the following instruments: reflecting telescope, refracting telescope, sextant, and quadrant

5.4 Distinguish between solar flares and solar prominences

6.0 SPACE

- 6.1 Define the terms: binary stars, nova, cepheids
- 6.2 Relate the use of the term spectra to the study of stars
- 6.3 Describe how the movement of stars are studied by astronomers
- 6.4 Know how "starlight" is analyzed

7.0 MATTER

7.1 Properties of matter

- 7.1.1 Define the terms weight and volume
- 7.1.2 Explain how gravity determines the weight of an object
- 7.1.3 Compare mass and weight
- 7.1.4 Know the meaning of the term "g" force
- 7.1.5 Interrelate mass and inertia

7.2 Measurements of matter

- 7.2.1 Apply the necessary skills and understandings to measure length, volume and mass-weight of various objects using the metric units
- 7.2.2 Understand the relationship of exact measurements to tolerance
- 7.2.3 Know the appropriate names for units used to measure length, mass-weight, volume and temperature in the metric system
- 7.2.4 Relate basic units of the metric system to familiar approximate equivalents of the English system

7.3 Forms of matter

- 7.3.1 Name three states of matter
- 7.3.2 Describe the properties related to each state of matter
- 7.3.3 Explain how matter can be changed from one form to another
- 7.3.4 Define the following terms: evaporation, condensation, sublimation, freezing, and melting
- 7.3.5 Demonstrate the change in volume due to a change in state of matter

7.4 Structure of matter

- 7.4.1 Know the symbols for common elements
- 7.4.2 Distinguish between metals and nonmetals
- 7.4.3 Define the term inert gases
- 7.4.4 Know the primary components of an atom
- 7.4.5 Interpret atomic numbers and atomic weights of common elements as found on the periodic table of elements
- 7.4.6 Relate the combination of atoms in forming molecules to their electron structure
- 7.4.7 Distinguish between chemical changes and physical changes
- 7.4.8 Know the law of definite proportions
- 7.4.9 Illustrate with equations the various types of chemical reactions
- 7.4.10 Understand the concepts of acids, bases, and salts
- 7.4.11 Categorize acids and/or bases using indicator paper
- 7.4.12 Determine relative strength of acids and/or bases by use of pH paper

7.5 Matter and energy relations

- 7.5.1 Define the term radioactivity
- 7.5.2 Name three kinds of radiation
- 7.5.3 Distinguish between natural isotopes and radioisotopes
- 7.5.4 Explain how nuclear changes release energy

- 7.5.5 Distinguish between nuclear fusion and nuclear fission
- 7.5.6 Discuss examples of present and possible future uses of nuclear energy

8.0 ENERGY

- 8.1 Define the term energy
- 8.2 Kinds of energy
 - 8.2.1 Describe energy that is kinetic
 - 8.2.2 Illustrate energy that is potential
 - 8.2.3 Mechanical energy
 - 8.2.3.1 Name four forms of mechanical energy
 - 8.2.3.2 Sound
 - 8.2.3.2.1 Demonstrate how sound is produced
 - 8.2.3.2.2 Describe what produces the loudness of sounds
 - 8.2.3.2.3 Define the following terms: amplitude, pitch, frequency, quality, decibel, doppler effect, resonance, intensity, and harmonic content
 - 8.2.3.2.4 Trace a sound wave from its source to the brain where it is interpreted
 - 8.2.4 Radiant energy
 - 8.2.4.1 Name the principle source of light energy
 - 8.2.4.2 Illustrate the way light travels
 - 8.2.4.3 Know the speed of light
 - 8.2.4.4 Define the terms: illumination, intensity, complimentary colors, and primary colors
 - 8.2.4.5 Describe the properties of light
 - 8.2.4.6 Explain how shadows are formed
 - 8.2.4.7 Name the major source of heat energy
 - 8.2.4.8 Relate the "kinetic molecular theory" to heat
 - 8.2.4.9 Know the units used for measuring heat energy
 - 8.2.4.10 Describe how heat energy can be transferred
 - 8.2.5 Electricity and magnetism
 - 8.2.5.1 Distinguish between current and static electricity
 - 8.2.5.2 Name two ways static electricity can be produced
 - 8.2.5.3 Describe three ways of producing current electricity
 - 8.2.5.4 Demonstrate the law of magnets
 - 8.2.5.5 Explain how you can determine the polarity of a bar magnet that has no affixed labeling
 - 8.2.5.6 Demonstrate the production of an electric field about a wire carrying a current
 - 8.2.5.7 Map the pattern of magnetic lines of force about a "U"-magnet

9.0 MACHINES

- 9.1 Force
 - 9.1.1 Define the term force
 - 9.1.2 Give the relationship among force, mass and energy
 - 9.1.3 Define the terms: velocity, acceleration, momentum, impulse, and newton
 - 9.1.4 Compare centrifugal and centripetal force giving two examples of each
 - 9.1.5 Relate friction to effective force available to do work
 - 9.1.6 Describe three ways of reducing friction
 - 9.1.7 Illustrate the effect friction has on moving materials
- 9.2 Work
 - 9.2.1 Define the term work
 - 9.2.2 Describe how work can be measured
 - 9.2.3 Give the metric units used in the calculations of the quantity of work accomplished in a given situation
 - 9.2.4 Relate work to energy
- 9.3 Machines
 - 9.3.1 Illustrate four kinds of simple machines
 - 9.3.2 Describe the uses of machines
 - 9.3.3 Illustrate the major parts of four simple machines
 - 9.3.4 Know how to determine the ideal mechanical advantage of a simple machine
 - 9.3.5 Demonstrate the way of determining the actual mechanical advantage of a simple machine
 - 9.3.6 Relate wedges and screws to incline planes
 - 9.3.7 Explain how combination of simple machines increase the mechanical advantages for compound machines
 - 9.3.8 Know how to determine the efficiency of a simple machine

EARTH AND SPACE SCIENCE

LEVEL 8

1.0 THE SOLID EARTH

- 1.1 Nature of the lithosphere
 - 1.1.1 Distinguish among atom, molecule, element, and compound
 - 1.1.2 Identify three sub-atomic particles
 - 1.1.3 Name the principle elements of the earth
 - 1.1.4 Describe the four zones of the earth
- 1.2 Physical geology
 - 1.2.1 Name the three classes of rocks and give two examples of each
 - 1.2.2 Describe the origin of the three classes of rocks
 - 1.2.3 List tests for rock and mineral identification
 - 1.2.4 Diagram the rock cycle
 - 1.2.5 Name the three major types of mountains and explain how each is formed
 - 1.2.6 Name three land forms and explain the origin of each
 - 1.2.7 Name two constructive forces that change the earth's surface
 - 1.2.8 Name two destructive forces that change the earth's surface
 - 1.2.9 Compute the density and specific gravity of earth materials
- 1.3 Historical geology
 - 1.3.1 Given some fossil evidence - such as shark tooth on a mountain - account for its presence in this location
 - 1.3.2 Distinguish among eon, era, epoch, and period
 - 1.3.3 Describe methods for determining the age of rocks and fossils
 - 1.3.4 Explain two methods of fossil formation
 - 1.3.5 List the three fossil fuels, explain their origins and their importance to man
 - 1.3.6 Discuss briefly how fossil fuels can be conserved
- 1.4 Soil
 - 1.4.1 Diagram a soil profile
 - 1.4.2 Distinguish between mechanical and chemical weathering
 - 1.4.3 List the two primary agents of erosion
 - 1.4.4 Describe three results of erosion by water
 - 1.4.5 Identify soil samples as either acidic or basic
 - 1.4.6 Briefly describe man's role as a destructive force and explain methods of soil conservation

2.0 THE HYDROSPHERE

- 2.1 Nature of water
 - 2.1.1 Explain the decomposition of water and give the chemical equation
 - 2.1.2 List three properties of water
 - 2.1.3 Explain the water cycle
- 2.2 Ground water
 - 2.2.1 Explain infiltration, porosity, permeability, and capillarity
 - 2.2.2 Construct a diagram to show the effects of rainy seasons and dry seasons on the water table
 - 2.2.3 Describe mineral spring, hot spring, and geyser formations, and state one way in which they differ
 - 2.2.4 Construct a diagram to show how springs and artesian wells are formed
 - 2.2.5 Explain the formation of caves, caverns, and sinkholes. Distinguish between stalagmites and stalactites
- 2.3 Surface water
 - 2.3.1 Describe two characteristics of each stage in the development of a river
 - 2.3.2 Show the relationship of stream gradient to stream load
 - 2.3.3 Explain how ox-bow lakes are formed
 - 2.3.4 Describe or diagram the formation of a delta
 - 2.3.5 List four ways in which water is polluted
 - 2.3.6 Describe at least three methods of water purification
- 2.4 Ocean water
 - 2.4.1 Explain the meaning of salinity and name the two most abundant elements in sea water
 - 2.4.2 Explain the relationship between temperature and density of sea water
 - 2.4.3 Diagram the ocean floor and label at least three of the following: continental shelf, continental slope, abyssal plain, basin, sea mount, ridge, canyon, trench
 - 2.4.4 Distinguish between surface currents and turbidity currents
 - 2.4.5 Name the oceans of the world
 - 2.4.6 Describe the major directions of oceanic currents due to the Coriolis effect

3.0 THE ATMOSPHERE

- 3.1 The nature of air
 - 3.1.1 List three properties of air
 - 3.1.2 Name the two major gases in the atmosphere and give the percentage of each
 - 3.1.3 Name the four major layers of the atmosphere and give one significant characteristic of each
- 3.2 Weather
 - 3.2.1 Name the three elements of weather and explain how each is measured
 - 3.2.2 Explain what causes wind

- 3.2.3 Show a similarity and a difference between a cloud and fog
- 3.2.4 Name three cloud formations and give one significant characteristic of each
- 3.2.5 Compare the four forms of precipitation according to formation
- 3.2.6 Describe the formation of dew and frost
- 3.2.7 Explain the difference between an anemometer and a wind vane
- 3.2.8 Compare hurricanes and tornadoes as to requirements for development, direction, size, and velocity
- 3.2.9 Name the four air masses and give the origin and symbol of each
- 3.2.10 Explain the difference between a cyclone and an anticyclone
- 3.2.11 Distinguish among the four weather fronts and be able to recognize each
- 3.2.12 Explain the difference between weather and climate
- 3.3 Air pollution
 - 3.3.1 List three causes of air pollution and explain how each can be controlled

4.0 ASTRONOMY

- 4.1 Theories relating to the origin of the solar system
 - 4.1.1 Explain two theories relating to the formation of the solar system
- 4.2 Galaxies
 - 4.2.1 Identify the three galactic systems
 - 4.2.2 Shown a diagram of the Milky Way, give the approximate location of our solar system
- 4.3 Stars
 - 4.3.1 Explain what is meant by star magnitude
 - 4.3.2 Describe the relationship between the color and temperature of a star
 - 4.3.3 Diagram Ursa Major, Ursa Minor, and Orion and label the pointer stars and Polaris
 - 4.3.4 The sun - our nearest star
 - 4.3.4.1.1 Given a diagram of the sun, label the photosphere, chromosphere, and corona
 - 4.3.4.1.2 Distinguish among solar flares, solar prominences, sunspots, and solar wind
 - 4.3.4.1.3 Compare the sun's diameter, mass, density, volume and luminosity to other stars
 - 4.3.4.1.4 Compare the size of the sun by diameter, mass, density, and volume to the earth and the moon
 - 4.3.4.1.5 Identify the approximate interior and exterior temperatures of the sun
 - 4.3.4.1.6 Describe how to observe properly the sun to detect sunspots
- 4.4 The planets
 - 4.4.1 Diagram the solar system
 - 4.4.2 Given a set of descriptive statements, associate them with the different planets
 - 4.4.3 Explain why all life on earth is dependent upon solar energy
 - 4.4.4 Explain the contribution of each of the following to planetary motion: Ptolemy, Copernicus, and Kepler
- 4.5 The moon
 - 4.5.1 Construct a surface diagram identifying craters, highlands, ridges, seas, rills, and rays
 - 4.5.2 Explain the moon's lack of atmosphere on the following: physical features, sound, life
- 4.6 Other celestial bodies
 - 4.6.1 Distinguish among nebula, nova, and supernova
 - 4.6.2 State the meaning for the following: comet, meteor, and asteroid
- 4.7 Fields and forces
 - 4.7.1 Explain why the earth is called a magnet
 - 4.7.2 Describe the motion of charged particles in the Van Allen belt
 - 4.7.3 Distinguish between centrifugal force and centripetal force
 - 4.7.4 Relate the effects of gravity on the weight of an object
 - 4.7.5 Distinguish among rotation, revolution, and inertia in relation to the size of a celestial body
 - 4.7.6 Explain the effects of gravity on freely falling objects. Relate this to the time of departure and return of a space vehicle

GENERAL SCIENCE

LEVEL 9

1.0 LIVING THINGS

1.1 Organization of living things

- 1.1.1 Describe the principle part of a cell
- 1.1.2 Explain how cells are grouped to form tissues
- 1.1.3 Relate the grouping of tissues to the formation of organs
- 1.1.4 Name the body systems of an animal
- 1.1.5 Explain how various organs are organized to form a system; example, circulatory system
- 1.1.6 Describe the function of the nucleic acids in cells
- 1.1.7 Know two ways cells reproduce
- 1.1.8 Explain the life processes that must be carried on by all organisms

1.2 Diversity of life

- 1.2.1 Give the distinguishing features among protista, plants, and animals
- 1.2.2 Explain how differences occur in the characteristics of similar organisms
- 1.2.3 Describe three relationships that occur among organisms related to survival techniques
- 1.2.4 Protista
 - 1.2.4.1 Name the smallest unit of life
 - 1.2.4.2 Describe one protista and give its methods of reproduction
 - 1.2.4.3 Differentiate between aerobic and anaerobic processes
 - 1.2.4.4 Relate the beneficial actions of three different protists to man
 - 1.2.4.5 Know the relationships of pathogenic organisms to the man's health
 - 1.2.4.6 Demonstrate the optimum conditions for bacteria growth
- 1.2.5 Plants
 - 1.2.5.1 Know the difference between simple green plants and vascular green plants
 - 1.2.5.2 Understand the relationship between plants without chlorophyll and the organic world
 - 1.2.5.3 Describe alternation of generations
 - 1.2.5.4 Relate the simple plants to the economy of man
 - 1.2.5.5 Know the relationship of plants to the food pyramid
 - 1.2.5.6 Vascular plants
 - 1.2.5.6.1 Distinguish between monocot and dicot plants
 - 1.2.5.6.2 Know the distinguishing features of broad-leaved and coniferous plants
 - 1.2.5.6.3 Describe the life cycle of an annual
 - 1.2.5.6.4 Diagram the life cycle of a bean
 - 1.2.5.6.5 Know the parts of a bean seed
 - 1.2.5.6.6 Describe the conditions necessary for the germination of a seed
 - 1.2.5.6.7 Name five beneficial uses of plants to other organisms
 - 1.2.5.6.8 Explain how stems grow in length
 - 1.2.5.6.9 Name four tropisms plants experience and identify the triggering stimulus for each
 - 1.2.5.6.10 Describe the photosynthesis process
 - 1.2.5.6.11 Name the essential materials and the products of photosynthesis
 - 1.2.5.6.12 Name five special adaptations found in plants
- 1.2.6 Animals
 - 1.2.6.1 Know eight phyla of animals
 - 1.2.6.2 Understand that animals are consumers
 - 1.2.6.3 Identify two examples of each of eight phyla of animals
 - 1.2.6.4 Know the cardinal characteristics of: sponges, coelenterates, flatworms, mollusks, annelids, arthropods, echinoderms, and chordata
 - 1.2.6.5 Describe the life processes of animals relating them to the complexity of the organisms "make-up"
 - 1.2.6.6 Identify one animal for which each of the following terms will apply: regeneration, parthenogenesis, larva, metamorphosis, exoskeleton, hibernation, lateral line, air sac
 - 1.2.6.7 Man
 - 1.2.6.7.1 Give the complete classification of man
 - 1.2.6.7.2 Name the parts of man's skeleton
 - 1.2.6.7.3 Illustrate the articulation between bones in each type of joint
 - 1.2.6.7.4 Describe how the skeleton is held together
 - 1.2.6.7.5 Name four functions of man's skeleton
 - 1.2.6.7.6 Relate good posture to proper functioning of man's skeleton
 - 1.2.6.7.7 Know the organs that make up the digestion system of man
 - 1.2.6.7.8 Trace a sample of a starch through the digestive system indicating the actions involved
 - 1.2.6.7.9 Know the useful product of digested fats, starches, and proteins
 - 1.2.6.7.10 Know the organs of the circulatory system of man
 - 1.2.6.7.11 Name the primary functions of the blood
 - 1.2.6.7.12 Describe the action of the heart in moving the blood
 - 1.2.6.7.13 Explain the relationship of the circulatory system to the excretory system

- 1.2.6.7.14 Relate the respiratory systems function to the circulatory system
- 1.2.6.7.15 Describe the nervous system of man
- 1.2.6.7.16 Name the senses of man and the stimuli each detects
- 1.2.6.7.17 Know the endocrine glands of man
- 1.2.6.7.18 Explain how the nervous system and hormones function to control growth and actions of the body
- 1.2.6.7.19 Care of the body
 - 1.2.6.7.19.1 Name four natural defenses against disease-causing microorganisms
 - 1.2.6.7.19.2 List four media by which microorganisms invade the body
 - 1.2.6.7.19.3 Distinguish between natural and acquired immunity
 - 1.2.6.7.19.4 Describe the effects of the following drugs on the body: marijuana, LSD, and heroin
 - 1.2.6.7.19.5 Relate the use of tobacco to the normal, healthy functions of the body
 - 1.2.6.7.19.6 Describe the effects of alcohol on the body

- 1.3 Balance in nature
 - 1.3.1 Diagram the water cycle
 - 1.3.2 Diagram the carbon dioxide-oxygen cycle
 - 1.3.3 Relate people to the problems of pollution
 - 1.3.4 Know the relationships of man to the Web-of-Life

2.0 MATTER

- 2.1 Properties of matter
 - 2.1.1 Explain gravity as a force
 - 2.1.2 Determine the density of a solid
 - 2.1.3 Demonstrate the specific properties of each state of matter
- 2.2 Measurements of matter
 - 2.2.1 Describe the standards for the metric units of length, mass, and volume
 - 2.2.2 Express numbers in the form of scientific notation
 - 2.2.3 Demonstrate accuracy in measuring time, length, volume, and weight using the metric system
- 2.3 Structure of matter
 - 2.3.1 Compare the physical properties of common elements
 - 2.3.2 Describe the arrangement of particles in the production of crystals
 - 2.3.3 Define the terms: solution, suspension, solute, solvent, emulsion, and alloy
 - 2.3.4 Know the significance of information communicated by chemical formulas
 - 2.3.5 Demonstrate each of the following types of chemical reactions: synthesis, analysis, decomposition, and replacement
 - 2.3.6 Know that chemical reactions can be represented by equations and that reactants and products must be balanced
 - 2.3.7 Relate the activity of an element to its structure
- 2.4 Matter - energy
 - 2.4.1 Trace the developments leading to the discovery of radiation
 - 2.4.2 Explain how energy is produced in a nuclear reactor
 - 2.4.3 Describe the unique features of a breeder reactor
 - 2.4.4 Know the contributions of the following to the nuclear sciences: Einstein, the Curies, J. J. Thompson, Rutherford, and Fermi

3.0 ENERGY

- 3.1 Sound energy
 - 3.1.1 Define the term echo
 - 3.1.2 Calculate distances using echoes and the speed of sound
 - 3.1.3 Demonstrate how sound waves can be absorbed
 - 3.1.4 Give the range of hearing for man in vibrations per second
- 3.2 Radiant energy
 - 3.2.1 Explain the reflection of light rays from a plane mirror
 - 3.2.2 Determine the angle of reflection from a plane mirror
 - 3.2.3 Distinguish between real and virtual images
 - 3.2.4 Illustrate the refraction of light through a container of water
 - 3.2.5 Demonstrate the means of measuring heat energy
- 3.3 Electricity and magnetism
 - 3.3.1 Relate the production of electricity to a voltaic cell
 - 3.3.2 Demonstrate the use of an electroscope
 - 3.3.3 Know Ohm's law and the use of the formula $I = E/R$
 - 3.3.4 Determine the resistance of a nonconductor using $1/R = 1/r + 1/r_2$
 - 3.3.5 Explain how a photoelectric cell functions
 - 3.3.6 Describe the storage of electricity in a battery
 - 3.3.7 Demonstrate the flow of current through a series circuit
 - 3.3.8 Differentiate between a series circuit and a parallel circuit
 - 3.3.9 Demonstrate a magnetic force driving an electric motor
 - 3.3.10 Explain how chemical energy can be changed into electricity

- 3.3.11 Explain the differences among materials that are paramagnetic, ferromagnetic, or diamagnetic

4.0 MACHINES

- 4.1 Force
- 4.1.1 Relate the amount of force required to overcome inertia to the amount of force required to keep a body in constant motion
 - 4.1.2 Know Newton's three laws of motion
 - 4.1.3 Relate the distance an object, falling free travels the first second to the distance it travels the fourth second
 - 4.1.4 Determine the velocity of a free falling object at the end of the third second
- 4.2 Work
- 4.2.1 Demonstrate an understanding of: $W = F \times P$ and $P = W/t$
 - 4.2.2 Illustrate the three classes of a lever
 - 4.2.3 Demonstrate that a pulley may be considered a special lever
 - 4.2.4 Compare the efficiency of the steam turbine to that of a reciprocating engine
 - 4.2.5 Explain the four strokes of a four-cycle internal combustion engine
 - 4.2.6 Compare a jet engine to a rocket engine
 - 4.2.7 Know the contributions of the following men in the development of engines: Prescott Watt, Fulton, George Stevenson, Goddard, von Braun, and Herman Oberth

5.0 THE EARTH

- 5.1 Lithosphere
- 5.1.1 Define the term diastrophism
 - 5.1.2 Distinguish between an anticline and a syncline
 - 5.1.3 Cite examples of mountains formed by diastrophism
 - 5.1.4 Explain how block mountains are formed
 - 5.1.5 Demonstrate the way in which mountain and continental glaciers have changed the earth's crust
 - 5.1.6 Compare the following forms of erosion: rill, shut, and gully
 - 5.1.7 Describe five ways of controlling erosion
 - 5.1.8 Demonstrate the principle upon which the seismograph is based
 - 5.1.9 Explain the reason petroleum is found between sandstone and salt
 - 5.1.10 Trace the formation of coal through the following stages: peat, lignite, bituminous, and anthracite
 - 5.1.11 Distinguish between precious and semiprecious stones
- 5.2 Hydrosphere
- 5.2.1 Oceans
 - 5.2.1.1 Give the use of the following devices in oceanography: bathyscaphe, sonar, coring devices, and scuba
 - 5.2.1.2 Describe the patterns of ocean currents in the northern hemisphere
 - 5.2.1.3 Give some examples of ocean pollution
 - 5.2.2 Rivers
 - 5.2.2.1 Locate the six largest river systems of the world
 - 5.2.2.2 Name two examples of rivers which have caused canyons and/or deltas
 - 5.2.2.3 Describe the causes of river pollution
- 5.3 Atmosphere
- 5.3.1 Describe the properties of gases comprising the air
 - 5.3.2 Explain the effect the coriolis has on prevailing winds
 - 5.3.3 Locate (on a map) and give the directions of the four major prevailing winds
 - 5.3.4 Distinguish between land breezes and sea breezes
 - 5.3.5 Explain how land features affect the wind
 - 5.3.6 Compare the origin and characteristics of tornadoes, waterspouts, hurricanes, thunderstorms, cyclones, and dust devils
 - 5.3.7 Compare the transmission of radio and television waves as relates to the atmosphere
 - 5.3.8 Explain how ozone is formed

6.0 THE SOLAR SYSTEM

- 6.1 Compare the Ptolemaic and Copernican systems of solar arrangement
- 6.2 Explain Bode's law
- 6.3 Gravitational attraction
- 6.3.1 Calculate the force of attraction between two bodies
 - 6.3.2 Calculate acceleration due to gravity
 - 6.3.3 Explain how opposing forces (centrifugal and centripetal) affect orbits
- 6.4 Graph positions according to latitude and longitude.
- 6.5 Explain the purpose of the International Date Line
- 6.6 Explain how a comet originates
- 6.7 The sun - our star
- 6.7.1 Compare the size of the sun to the size of other familiar stars
 - 6.7.2 Explain the process of nuclear fusion in the sun as the source of energy
 - 6.7.3 Discuss the use of solar energy at the present time and the possible role of solar energy in the future

6.8 The stars

- 6.8.1 Explain how the magnitude of a star is determined
- 6.8.2 Distinguish between motion and apparent motion in stars
- 6.8.3 Discuss problems men must face in space (temperature, weightlessness, inertia, time, etc.) to travel to other planets, other solar systems, and other galaxies

PHYSICAL SCIENCE

LEVEL 9

1.0 DEVELOPING SYSTEMS AND SKILLS OF MEASUREMENT

- 1.1 Early methods of measurement
 - 1.1.1 Explain the need for uniformity in methods of measurement
 - 1.1.2 Relate earlier units of measurement to parts of the human body
- 1.2 English system
 - 1.2.1 List several units used to express length, weight, and volume
 - 1.2.2 Calculate an equivalent value for distance, such as yards to inches or feet to chains
 - 1.2.3 Calculate an equivalent value of weight, such as pounds to tons or pounds to ounces
 - 1.2.4 Calculate an equivalent value of volume, such as pints to gallons or cubic inches to cubic feet
 - 1.2.5 Point out that no uniformity exist in the English system of related units of measurement
 - 1.2.6 Show that our nation, as a part of the scientific world, should conform to a uniform system of measurement
- 1.3 The Metric System
 - 1.3.1 Relate the uniformity of the units of the Metric System
 - 1.3.2 Calculate several equivalent values for length, mass, and capacity in metric units
 - 1.3.3 Demonstrate an understanding of the values of the metric prefixes
 - 1.3.4 Acquire a workable understanding of expressing numbers in scientific notation and powers of ten
 - 1.3.5 Demonstrate the simplicity of expressing very large and very small quantities with powers of ten notation
 - 1.3.6 Use the slide rule as an aid to computation
- 1.4 Temperature scales
 - 1.4.1 Describe three different temperature scales and relate their uses in every day life situations and scientific studies
 - 1.4.2 Compare and contrast the Celsius, Fahrenheit, and Kelvin scales in problem solving
 - 1.4.3 Demonstrate the general gas laws and explain why the Kelvin temperature scale functions proportionally to volume or pressure

2.0 UNDERSTANDING MATTER

- 2.1 Basic properties
 - 2.1.1 Volume
 - 2.1.1.1 Explain the concept of volume
 - 2.1.1.2 Demonstrate the concept of volume
 - 2.1.1.3 List different volume units and explain relationships between each
 - 2.1.1.4 Demonstrate shortcomings in volume measurements
 - 2.1.1.5 Measure the volume of a gas, a liquid, and a solid in metric units
 - 2.1.2 Mass
 - 2.1.2.1 Compare metric mass units to English weight units
 - 2.1.2.2 Explain the difference as a comparison between weight and mass
 - 2.1.2.3 Demonstrate, using the balance, a method of determining mass
- 2.2 States of matter
 - 2.2.1 Solids
 - 2.2.1.1 Make a list of the specific properties of solids
 - 2.2.1.2 List several materials that are classified as solids
 - 2.2.1.3 Demonstrate the meaning of density and specific gravity showing the relationship between each
 - 2.2.1.4 Explain the "kinetic molecular theory" with regard to the solid state of matter
 - 2.2.1.5 Discuss factors that cause a change of state in matter, i.e., melting point, boiling point, heat of fusion, heat of vaporization, etc.
 - 2.2.2 Liquids
 - 2.2.2.1 List and discuss the liquid properties of matter
 - 2.2.2.2 Demonstrate the effect of heat upon a liquid
 - 2.2.2.3 Demonstrate Pascal's principle by applying pressure to a confined liquid
 - 2.2.2.4 Explain the "kinetic molecular theory" as it pertains to liquids
 - 2.2.2.5 Demonstrate Archimede's principle using several different liquids and several different solids with a specific gravity greater than that of the liquid
 - 2.2.3 Gases
 - 2.2.3.1 Compare the properties of gases to those of liquids and solids
 - 2.2.3.2 Compare the specific gravity of CO_2 and CH_4 to air using the scale balance
 - 2.2.3.3 Discuss the flight of aircraft as related to gases
 - 2.2.3.4 Demonstrate gas diffusion as it relates to the "kinetic molecular theory"
- 2.3 Classes of matter
 - 2.3.1 Elements
 - 2.3.1.1 Make a list of elements that exist as gases, liquids, and solids
 - 2.3.1.2 List other classes of matter and show that these classes exist as a combination of the elements
 - 2.3.2 Compounds
 - 2.3.2.1 Demonstrate how two or more elements may chemically combine to form a compound

- 2.3.2.2 Explain the "Law of Definite Composition of Compounds"
- 2.3.2.3 Demonstrate the "Law of Definite Composition of Compounds"
- 2.3.2.4 Explain exothermic and endothermic energy involved in the formation and breaking down of compounds
- 2.3.2.5 Demonstrate exothermic and endothermic energy involved in the formation and breaking down of compounds
- 2.3.2.6 List five naturally existing compounds
- 2.3.2.7 Describe five naturally existing compounds
- 2.3.3 Mixtures
 - 2.3.3.1 Explain the difference between homogeneous and heterogeneous mixtures
 - 2.3.3.2 Illustrate the difference between homogeneous and heterogeneous mixtures
 - 2.3.3.3 Explain that some mixtures contain uniform properties
 - 2.3.3.4 Explain and/or demonstrate how mixtures of gases, liquids, and solids may be separated
- 2.4 Changes in matter
 - 2.4.1 Physical change
 - 2.4.1.1 Explain the properties of a physical change
 - 2.4.1.2 Demonstrate the properties of a physical change
 - 2.4.1.3 Describe the difference between a physical change, chemical change, and a nuclear change
 - 2.4.1.4 Discuss the factors that can cause a physical change
 - 2.4.1.5 Describe how to measure the heat content of a substance
 - 2.4.1.6 Explain the meaning of the terms caloric and BTU in relation to measuring thermal energy
 - 2.4.2 Chemical change
 - 2.4.2.1 Describe the properties of the reactants and the products formed in a chemical reaction
 - 2.4.2.2 Demonstrate the four types of chemical reactions
 - 2.4.2.3 Demonstrate the effect of a catalyst during a chemical reaction
 - 2.4.2.4 Illustrate the energies involved in an exothermic and an endothermic reaction

3.0 ASPECTS OF ENERGY

- 3.1 Understanding concepts of energy, work, and power
 - 3.1.1 Energy
 - 3.1.1.1 Define the term energy
 - 3.1.1.2 Illustrate that energy is the ability to do work
 - 3.1.1.3 Show that energy can be converted from one form to another
 - 3.1.1.4 Distinguish between potential and kinetic energy
 - 3.1.2 Work
 - 3.1.2.1 Explain concept of work by demonstration with force-distance examples
 - 3.1.2.2 Discuss advantages and disadvantages of friction and resistance forces that affect work
 - 3.1.2.3 Develop understanding of work units--ft.-lb., erg, joule
 - 3.1.3 Power
 - 3.1.3.1 Demonstrate power as the rate of doing work
 - 3.1.3.2 Compare the work units of horse power and watts
- 3.2 Forms of energy
 - 3.2.1 Mechanical energy and machines
 - 3.2.1.1 Establish concept that mechanical energy is produced when a body is in motion
 - 3.2.1.2 Demonstrate that work is done when bodies rotate, reciprocate, or move in a wave pattern
 - 3.2.1.3 Show that machines are used to multiply force, change the direction of a force, gain speed, or gain distance
 - 3.2.1.4 Compute theoretical advantage, actual mechanical advantage, and the efficiency of a machine
 - 3.2.1.5 Demonstrate the fact that total output of a machine always equals total input less friction
 - 3.2.1.6 Different forces in action
 - 3.2.1.6.1 Illustrate forces involving solids
 - 3.2.1.6.2 Illustrate forces involving liquids
 - 3.2.1.6.3 Explain forces involved in atmospheric weather conditions
 - 3.2.1.7 Laws of motion
 - 3.2.1.7.1 Explain that a body at rest will remain in that state until an unbalanced force acts upon it
 - 3.2.1.7.2 Demonstrate that a body in motion will continue in motion unless another force causes it to change
 - 3.2.1.7.3 Explain that for every action there is an equal and opposite reaction
 - 3.2.1.7.4 Explain acceleration and deceleration
 - 3.2.2 Heat energy
 - 3.2.2.1 Compare the "kinetic molecular theory" to the "atomic theory" in relation to the concept of heat
 - 3.2.2.2 Demonstrate the conversion of other forms of energy into heat

- 3.2.2.3 Demonstrate the effect of heat upon gases, liquids, and solids
- 3.2.2.4 Explain and demonstrate the three concepts of heat transfer--conduction, convection, radiation
- 3.2.2.5 Explain temperature as a measure of thermal energy
- 3.2.3 Electric energy
 - 3.2.3.1 Explain the meaning of electrical terms--volt, ampere, ohm, watt
 - 3.2.3.2 Illustrate the meaning of electrical terms--volt, ampere, ohm, watt
 - 3.2.3.3 Discuss principle and method of producing D.C. and A.C. currents
 - 3.2.3.4 Explain the components that make up a complete circuit
 - 3.2.3.5 Illustrate the difference between parallel and series circuits
 - 3.2.3.6 Demonstrate how voltage and amperage is regulated in a circuit
 - 3.2.3.7 Explain how voltage and amperage is regulated in a circuit
 - 3.2.3.8 List five applications of electrical energy and discuss each
- 3.2.4 Sound energy
 - 3.2.4.1 Explain how sounds are produced
 - 3.2.4.2 Give three modes of transmission of sounds
 - 3.2.4.3 Compare the speed of sound in gases, liquids, and solids
 - 3.2.4.4 Explain the relationship between frequency and velocity of sound
 - 3.2.4.5 Compare sound with electric energy in communication
- 3.2.5 Light energy
 - 3.2.5.1 List four properties of light
 - 3.2.5.2 Compare the properties of sound and light
 - 3.2.5.3 Compare electromagnetic propagated waves to the properties of light waves using diffraction gratings or two polaroid lens
 - 3.2.5.4 Compare the wave theory and particle theory of light
 - 3.2.5.5 Describe make up of the photo-electric cell and list some of its uses
- 3.2.6 Nuclear energy
 - 3.2.6.1 List four peace time uses of nuclear energy
 - 3.2.6.2 Describe the historical development of nuclear energy
 - 3.2.6.3 Explain the theory of how nuclear energy is produced and controlled
 - 3.2.6.4 Discuss methods of detecting nuclear energy
 - 3.2.6.5 Explain how radioactive isotopes are produced
 - 3.2.6.6 Discuss several uses for radioactive isotopes

4.0 APPLIED USES OF PHYSICAL SCIENCE

- 4.1 The academic student
 - 4.1.1 Discuss the significance of physical science as a prerequisite to high school physics and chemistry
 - 4.1.2 Explain the need of all people having a basic understanding of material behavior
- 4.2 The terminal student
 - 4.2.1 List and discuss requirements for successful employment in construction, refrigeration, mechanics, electrical repair, plant supervision, etc.
 - 4.2.2 Research local areas for employment opportunities of industrial nature and list requirements
 - 4.2.3 Visit with employers of technical personnel and discuss employment requirements

BIOLOGY

1.0 THE NATURE OF LIFE

1.1 The science of life

- 1.1.1 Biology as a science
 - 1.1.1.1 Define the term biology
- 1.1.2 The historical background of the science of biology
 - 1.1.2.1 Give the names of five early scientists who helped to develop the science of biology and the contribution made by each
 - 1.1.2.2 Discuss the rapid development of the science biology by such means as international cooperation, advancement in related sciences, public acceptance of new knowledge, replacing superstition with facts, academic freedom, more money available, better tools for use in research, etc.
- 1.1.3 The microscope as a tool
 - 1.1.3.1 Name the structures of a compound microscope and tell the function of each part
 - 1.1.3.2 Label a drawing of a compound microscope
 - 1.1.3.3 Describe how to focus a compound microscope correctly
 - 1.1.3.4 Know how to prepare slides for class using the microscope
- 1.1.4 Scientific methods
 - 1.1.4.1 List and explain the steps involved in the technical method
 - 1.1.4.2 List and explain the steps involved in the research method
- 1.1.5 Terminology
 - 1.1.5.1 Correctly pronounce, spell, define, and use the scientific terms presented in the study of the science of life

1.2 The living condition

- 1.2.1 The close relationship between the non-living and the living worlds
 - 1.2.1.1 Explain how materials from the non-living world get into the living world to become components of protoplasm
 - 1.2.1.2 Explain how energy from the sun comes into the living world to provide the chemical energy necessary for life
- 1.2.2 State the biologist's concept of an organism
- 1.2.3 Spontaneous generation versus biogenesis
 - 1.2.3.1 Relate the belief held in the idea of spontaneous generation
 - 1.2.3.2 Give the meaning of biogenesis
 - 1.2.3.3 Describe the experimental work done by Redi, Spallanzani, and Pasteur in the effort to disprove the idea of spontaneous generation
 - 1.2.3.4 Give directions for performing a laboratory experiment based on the work of Spallanzani or Pasteur which disproves spontaneous generation
- 1.2.4 List nine conditions that we associate with the living condition and briefly explain each one
- 1.2.5 Variations and adaptations
 - 1.2.5.1 State how survival is related to variations and adaptations
 - 1.2.5.2 Explain why some animals and plants have become extinct

1.3 The chemical basis of life

- 1.3.1 Foundations of life
 - 1.3.1.1 Name the source of the matter required in the living world
 - 1.3.1.2 Name the source of the energy that must come into the living world
 - 1.3.1.3 List the chemical substances essential in a living system
 - 1.3.1.4 State the purpose of digestion
- 1.3.2 Matter
 - 1.3.2.1 Define the term matter
 - 1.3.2.2 Explain how the physical association of particles of matter determine whether matter is in the solid, liquid, or gaseous state
- 1.3.3 Changes in matter
 - 1.3.3.1 Illustrate a physical change in matter by using water and changing it from a liquid to a solid or a gaseous state
 - 1.3.3.2 Use electrolysis of water to explain the idea of chemical change
- 1.3.4 Energy and energy changes
 - 1.3.4.1 Define the term energy
 - 1.3.4.2 Define and give three examples of potential energy
 - 1.3.4.3 Define and give three examples of kinetic energy
 - 1.3.4.4 Give an example of the conversion of potential energy to kinetic energy
- 1.3.5 Elements
 - 1.3.5.1 Define the term element
 - 1.3.5.2 Know the number of the known elements
 - 1.3.5.3 Name the unit of structure of an element
- 1.3.6 The structure of an atom
 - 1.3.6.1 Describe where electrons, protons, and neutrons are located in the atom, and name the electric charge carried by each
- 1.3.7 Atomic number and atomic mass
 - 1.3.7.1 Know the atomic number and the atomic mass of the carbon atom which has six electrons, six protons, and six neutrons
- 1.3.8 Isotopes
 - 1.3.8.1 Define the term isotope
 - 1.3.8.2 Draw a diagram showing three isotopes of hydrogen

- 1.3.9 Radioisotopes
 - 1.3.9.1 Define the term radioisotopes
 - 1.3.9.2 Name three naturally occurring radioisotopes
 - 1.3.9.3 Know how non-radioactive isotopes are made radioactive
 - 1.3.9.4 List some uses of radioisotopes
- 1.3.10 Chemical activity
 - 1.3.10.1 Explain how the number and arrangement of electrons of an atom can determine its chemical activity by defining these terms: active element, inactive element, chemical stability, covalent bonds, ionic bonds, and ions
- 1.3.11 Compounds
 - 1.3.11.1 Define the terms: compounds, molecular compound, and ionic compound
 - 1.3.11.2 Give an example of a molecular compound and one of an ionic compound
- 1.3.12 Mixtures
 - 1.3.12.1 List at least five properties that distinguish a mixture from a compound
- 1.3.13 Solutions
 - 1.3.13.1 Define the terms: solution, solvent, solute, dilute solution, concentrated solution, saturated solution, molecular solution, ionic solution, and electrolyte
 - 1.3.13.2 Give the importance of solutions in the chemical activities of living organisms
 - 1.3.13.3 List five ways in which ions are important in the chemical activities of living organisms
- 1.3.14 Suspensions
 - 1.3.14.1 Define the terms suspension, colloidal suspension, phase reversal, reversible colloid, and irreversible colloid
 - 1.3.14.2 Explain: "Protoplasm can be described as a colloidal suspension."
- 1.3.15 Water and carbon dioxide
 - 1.3.15.1 List six ways in which living organisms depend on water
 - 1.3.15.2 Diagram the oxygen-carbon dioxide cycle
 - 1.3.15.3 Know the general name for the compounds built up around carbon
 - 1.3.15.4 Explain why green plants can be called the vital chemical link between the inorganic compounds and the living world
- 1.3.16 Carbon, the key to organic compounds
 - 1.3.16.1 State three chemical properties that make carbon the key element of organic compounds
 - 1.3.16.2 Demonstrate what is meant by single, double, and triple bonds
 - 1.3.16.3 Define the term unsaturated bonds and tell how they can be saturated
 - 1.3.16.4 Define the term biosynthesis
- 1.3.17 The nature of carbohydrates
 - 1.3.17.1 Name the three elements that compose carbohydrates
 - 1.3.17.2 Explain why carbohydrates are considered to be vital fuel nutrients for plants and animals
 - 1.3.17.3 Sugars
 - 1.3.17.3.1 Define and give the formula for the following: monosaccharide, disaccharide, polysaccharide, hexose sugar, and pentose sugar
 - 1.3.17.4 Starches
 - 1.3.17.4.1 Diagram the formation of polysaccharides from glucose units
 - 1.3.17.4.2 Give the general chemical formula for a polysaccharide
 - 1.3.17.4.3 Name the process by which polysaccharides can be broken down into glucose
- 1.3.18 Lipids, fats, oils, and related substances
 - 1.3.18.1 Name the three most abundant lipids
 - 1.3.18.2 Name two basic units which compose fat molecules and describe each
 - 1.3.18.3 Define the term unsaturated fat
 - 1.3.18.4 Describe the process by which some vegetable oils are changed into a more saturated form to make oleomargarine or shortening
- 1.3.19 Proteins and amino acids
 - 1.3.19.1 Describe the chemical structure of an amino acid
 - 1.3.19.2 Know the chemical formula for the amino group and the organic acid group
 - 1.3.19.3 Identify the kind of bonds that link the amino group of an amino acid to the organic acid group
 - 1.3.19.4 Explain why a protein is called a polypeptide
 - 1.3.19.5 Explain how parallel polypeptide chains are cross-linked
 - 1.3.19.6 Know why nitrogen is sometimes called the key element of proteins
 - 1.3.19.7 List the primary chemical components of a protein
 - 1.3.19.8 List five important structural and functional characteristics of the living condition in which proteins play an important role
 - 1.3.19.9 Describe a complete protein
- 1.3.20 The vital role of enzymes
 - 1.3.20.1 Define the terms: catalyst, and biochemical or organic catalyst
 - 1.3.20.2 Know the evidence which indicates enzyme specificity

- 1.3.20.3 Define the terms: specific, substrate, active sites, enzyme, substrate complex, enzyme system, and coenzyme
- 1.3.20.4 Describe the functional role of coenzymes as donors and acceptors in chemical reactions
- 1.3.21 The organization of nucleic acids
 - 1.3.21.1 Name the contribution to research on deoxyribonucleic acid made by James D. Watson and F. H. C. Crick
 - 1.3.21.2 Deoxyribonucleic acid
 - 1.3.21.2.1 Make a labeled drawing of DNA molecule
 - 1.3.21.2.2 List the components of the side strands of the DNA molecule
 - 1.3.21.2.3 Know the two classes of nitrogen bases and the two kinds of bases under each class that forms the crosspieces of the DNA helix
 - 1.3.21.2.4 Diagram the pairing arrangement between the two purines and the two pyrimidines
 - 1.3.21.2.5 Name the bonds which hold the nitrogen bases together
 - 1.3.21.2.6 Identify the component of the side strand to which the nitrogen bases are attached
 - 1.3.21.2.7 List the components of the DNA nucleotide
 - 1.3.21.3 Ribonucleic acid
 - 1.3.21.3.1 Describe the physical structure of RNA
 - 1.3.21.3.2 Name the chemical components of the side strand of RNA
 - 1.3.21.3.3 Identify the nitrogen bases of RNA
- 1.3.22 List four differences between DNA and RNA
- 1.3.23 Define the terms: replication and duplication of DNA
- 1.3.24 Name the product that results from each replication or duplication of DNA
- 1.4 The structural basis of life
 - 1.4.1 Cell theory
 - 1.4.1.1 Know the contributions made by: Robert Hooke, Dujardin, Matthias, Schleiden, and Theodor Schwann
 - 1.4.1.2 State the cell theory
 - 1.4.1.3 List at least five methods by which understanding of the cell structure and physiology of the cell has been increased
 - 1.4.1.4 Explain the statement, "The cell is the common denominator of life."
 - 1.4.2 List and describe the general functions involved in the eleven processes that characterize the living condition
 - 1.4.3 The structure of the animal cell
 - 1.4.3.1 Membranes
 - 1.4.3.1.1 Define the terms interface and membrane
 - 1.4.3.1.2 Locate and state the importance of the plasma membrane
 - 1.4.3.1.3 Describe the molecular structure of the plasma membrane
 - 1.4.3.1.4 List the properties of the plasma membrane that enables it to do its work
 - 1.4.3.1.5 Locate the endoplasmic reticulum of an animal cell
 - 1.4.3.1.6 Describe the endoplasmic reticulum of an animal cell
 - 1.4.3.1.7 Know the function of the endoplasmic reticulum of an animal cell
 - 1.4.3.1.8 Describe the nuclear membrane as to structure and function
 - 1.4.3.1.9 Identify the perinuclear space
 - 1.4.3.1.10 Know the reason for there being a membrane around every organelle
 - 1.4.3.2 Cytoplasmic structures
 - 1.4.3.2.1 Know the function of the nucleus
 - 1.4.3.2.2 Name the important structures of the nucleus
 - 1.4.3.2.3 Locate the mitochondria using a model of an animal cell
 - 1.4.3.2.4 Know the function of mitochondria
 - 1.4.3.2.5 Know the general function of the following organelles: lysosomes, Golgi bodies, ribosomes, centrosome complex, and peroxisomes
 - 1.4.4 The structure of a plant cell
 - 1.4.4.1 Cell walls
 - 1.4.4.1.1 Identify the following: primary cell wall, secondary cell wall, middle lamella, pectin, cellulose, and lignin
 - 1.4.4.2 Vacuoles
 - 1.4.4.2.1 Name the large vacuole in the plant cell and give its function
 - 1.4.4.2.2 Give the function of the other cell vacuoles
 - 1.4.4.3 Organelles
 - 1.4.4.3.1 List the organelles of the plant cell that are also found in the animal cell
 - 1.4.4.3.2 Name an organelle found in the animal cell that is not found in the plant cell
 - 1.4.4.3.3 Plastids
 - 1.4.4.3.3.1 Name the three kinds of plastids
 - 1.4.4.3.3.2 List the three main pigments found in plastids and know the color of each

- 1.4.4.3.3.3 locate the anthocyanins and list the shades of color they give
- 1.4.4.3.3.4 Draw and label a chloroplast, indicating the function of each part
- 1.4.5 List the five levels of cellular organization and give an example of each
- 1.4.6 Explain what is meant by cell differentiation and cell specialization
- 1.5 The cell and its environment
 - 1.5.1 Homeostasis
 - 1.5.1.1 Define the term homeostasis
 - 1.5.1.2 List the reasons why it is necessary for a living system to maintain a steady or balanced state
 - 1.5.1.3 Understand how an animal is able to survive because of homeostatic adjustments
 - 1.5.1.4 Know three examples of homeostatic adjustments on the organ and system levels of development
 - 1.5.1.5 Describe four examples of homeostatic regulations in body fluids
 - 1.5.2 Permeability of membranes
 - 1.5.2.1 Distinguish between permeable and differentially permeable membranes
 - 1.5.2.2 Know why cell membranes must be differentially permeable
 - 1.5.3 Diffusion
 - 1.5.3.1 Demonstrate the diffusion of gases
 - 1.5.3.2 Explain how temperature and pressure influence diffusion rate
 - 1.5.3.3 Illustrate diffusion through a differentially permeable membrane
 - 1.5.4 Osmosis
 - 1.5.4.1 Define the terms: osmosis, osmotic system, turgor, turgid cell, plasmolysis, passive transport, active transport, hypertonic solution, hypotonic solution, cytolysis and plasmolysis
 - 1.5.4.2 Explain how the strength of the solution affects the direction of passage through the membrane
 - 1.5.5 Describe the entry of substances into a cell by pinocytosis
- 1.6 Cell nutrition
 - 1.6.1 Photosynthesis
 - 1.6.1.1 Define the term photosynthesis
 - 1.6.1.2 Name the organisms which can carry on photosynthesis
 - 1.6.1.3 The machinery of photosynthesis
 - 1.6.1.3.1 Describe a chloroplast
 - 1.6.1.3.2 Draw a diagram of a granum
 - 1.6.1.3.3 List four kinds of chlorophylls
 - 1.6.1.3.4 Designate the chlorophyll which is present in all photosynthetic organisms
 - 1.6.1.3.5 Name two chlorophylls which usually occur in seed plants
 - 1.6.1.3.6 Know the reason why chlorophyll is called a catalyst
 - 1.6.1.3.7 Name the important function of chlorophyll "a"
 - 1.6.1.3.8 Name the important functions of chlorophylls "b," "c," and "d"
 - 1.6.1.3.9 List some other pigments that transferred energy to chlorophyll "a"
 - 1.6.1.4 Write the equation for photosynthesis
 - 1.6.1.5 Illustrate where the reactants show up in the products of photosynthesis
 - 1.6.1.6 The light reactions
 - 1.6.1.6.1 Explain why the cyclic pattern of photolysis is not important in photosynthesis
 - 1.6.1.6.2 The non-cyclic pattern of photolysis
 - 1.6.1.6.2.1 State the kind of energy required for this phase of photolysis
 - 1.6.1.6.2.2 Explain the meaning of energized chlorophyll
 - 1.6.1.6.2.3 Know the two results of the use of the energy from the energized chlorophyll
 - 1.6.1.6.2.4 List in order the first and second energy carriers
 - 1.6.1.6.2.5 State what becomes of the hydrogen and oxygen when the water molecule is split
 - 1.6.1.6.2.6 Identify NADP and NADPH
 - 1.6.1.6.2.7 Know what is done with the H_2 of NADPH₂
 - 1.6.1.6.2.8 Draw a labeled diagram of the non-cyclic pattern of photolysis
 - 1.6.1.7 The carbon dioxide fixation cycle of photosynthesis - dark reaction
 - 1.6.1.7.1 State the kind of energy required for the dark reaction
 - 1.6.1.7.2 Know how the energy is supplied for the dark reaction
 - 1.6.1.7.3 Describe the importance of ribulose diphosphate (RDP) in the carbon dioxide fixation cycle
 - 1.6.1.7.4 Name the first stable product of the dark reaction
 - 1.6.1.7.5 Name the end product of the dark reaction
 - 1.6.1.7.6 List several organic compounds that can be formed from PGAL

- 1.6.1.7.7 Make a labeled diagram of the reactions that are involved in the carbon dioxide cycle and explain them
- 1.6.1.8 Know the biological significance of photosynthesis
- 1.6.1.9 Diagram the synthesis of glucose from PGAL
- 1.6.2 Explain how purple sulfur bacteria synthesize carbohydrates without using light
- 1.6.3 Understand the nutritional relationships between autotrophs and heterotrophs
- 1.7 Cell metabolism
 - 1.7.1 Define the term metabolism
 - 1.7.2 Distinguish between anabolic and catabolic phases of metabolism
 - 1.7.3 Protein synthesis (anabolic)
 - 1.7.3.1 Explain why protein synthesis is a universal cellular process
 - 1.7.3.2 Explain why proteins are indispensable for life
 - 1.7.3.3 Know reasons why an understanding of the structure and function of DNA and RNA is necessary in order to understand protein synthesis
 - 1.7.3.4 Explain the meaning of "genetic code"
 - 1.7.3.5 Understand the chemical mechanisms by which DNA controls protein synthesis
 - 1.7.3.6 Explain the role of transfer RNA, messenger RNA, and ribosomal RNA in protein synthesis
 - 1.7.3.7 Define the term amino acids and state the number known at the present time
 - 1.7.3.8 Explain the statement that, "The RNA units (codons) are specific to the amino acids"
 - 1.7.3.9 Draw a labeled diagram of protein synthesis with the RNA units placing the amino acids in the correct position along the RNA template on the surface of the ribosome
 - 1.7.4 Cellular respiration
 - 1.7.4.1 Aerobic respiration
 - 1.7.4.1.1 Define the term aerobic respiration
 - 1.7.4.1.2 Know the biological importance of respiration
 - 1.7.4.1.3 State the amount of energy released in the complete breakdown of one molecule of glucose
 - 1.7.4.1.4 Glycolysis
 - 1.7.4.1.4.1 Diagram the reactions that occur in converting one molecule of glucose into two molecules of pyruvic acid
 - 1.7.4.1.4.2 Know why glycolysis is called an anaerobic process
 - 1.7.4.1.4.3 Name the part of the cell in which glycolysis occurs
 - 1.7.4.1.5 Krebs cycle (citric acid cycle)
 - 1.7.4.1.5.1 Name the organelle in which the Krebs cycle occurs
 - 1.7.4.1.5.2 Draw and label a diagram of the reactions that occur in the Krebs cycle
 - 1.7.4.1.5.3 Write a summary of the Krebs cycle reactions
 - 1.7.4.1.5.4 Describe the energy transport system in the cell
 - 1.7.4.2 Anaerobic respiration (fermentation)
 - 1.7.4.2.1 Define the term anaerobic respiration
 - 1.7.4.2.2 Name the way in which glycolysis in fermentation is similar to glycolysis in aerobic respiration
 - 1.7.4.2.3 Name the two end products, other than carbon dioxide, released in alcoholic and lactic acid fermentation
- 1.8 Cell growth and reproduction
 - 1.8.1 Cell growth
 - 1.8.1.1 Explain how a living cell grows
 - 1.8.1.2 Understand the critical relationship between cell volume and the area of the surface membrane
 - 1.8.1.3 Know what happens when this relationship (volume to area) reaches its limits
 - 1.8.1.4 Identify the term applied to the cell that is ready to divide
 - 1.8.2 Cell division in somatic cells
 - 1.8.2.1 Define mitosis and tell the purpose of mitosis
 - 1.8.2.2 List the five phases of mitotic division
 - 1.8.2.3 Describe in detail the events that occur in each phase
 - 1.8.2.4 Cytokinesis - division of the cytoplasm
 - 1.8.2.4.1 Explain how division of the cytoplasm takes place in the animal cell
 - 1.8.2.4.2 Explain how the division of the cytoplasm takes place in the plant cell
 - 1.8.2.5 Draw a labeled diagram showing cell division in a somatic cell
 - 1.8.3 Cell division - the maturation of gametes
 - 1.8.3.1 Define meiosis and tell the purpose of meiosis

- 1.8.3.2 Describe the events that occur in the first and second meiotic divisions of the oögonial cell to form one functional egg
- 1.8.3.3 Describe the events that occur in the first and second meiotic divisions of spermatogonia to form four functional spermatids
- 1.8.3.4 Make a labeled diagram of oögenesis and one of spermatogenesis
- 1.8.4 Asexual reproduction
 - 1.8.4.1 Define the term asexual reproduction
 - 1.8.4.2 Know five examples of asexual reproduction

2.0 CONTINUITY OF LIFE

2.1 Genetics - the science of heredity

- 2.1.1 Gregor Mendel's contributions to genetics
 - 2.1.1.1 Name three principles of heredity which were discovered by Mendel
 - 2.1.1.2 Name the law which is based on Mendel's reasoning that a pair of "elements" (genes) was separated in different gametes during meiosis
 - 2.1.1.3 Diagram a cross between a homozygous tall pea plant and a homozygous short pea plant
 - 2.1.1.4 Give the ratios, genotypically and phenotypically of the offspring which result from crossing two pea plants which are heterozygous for stem length
 - 2.1.1.5 Using the Punnet method, illustrate a dihybrid cross, tabulating the resulting ratios
 - 2.1.1.6 Outline a method by which it would be possible to determine if a guinea pig is heterozygous or homozygous for the short-hair trait
- 2.1.2 Development of the chromosome theory of inheritance
 - 2.1.2.1 State August Weismann's contribution to the chromosome theory
 - 2.1.2.2 Name the three men who discovered Mendel's papers in 1910 and started a landslide of investigation and discovery in genetics
 - 2.1.2.3 Name the man who proposed the theory that chromosomes are composed of genes
 - 2.1.2.4 Define the terms gene and allele
 - 2.1.2.5 Give Sutton's reason for believing that the genes involved in Mendel's studies must have been on different chromosomes
 - 2.1.2.6 Explain incomplete dominance by diagramming a cross between a white four-o'clock and a red four-o'clock
 - 2.1.2.7 Name the insect used by Thomas Hunt Morgan and his associates in their research
 - 2.1.2.8 Distinguish between sex chromosomes and autosomes
 - 2.1.2.9 Give an example of a sex-linked trait in Drosophila melanogaster
 - 2.1.2.10 Define non-disjunction and name the man who discovered it
 - 2.1.2.11 Diagram and name the process by which new gene linkages may occur during tetrad formation in meiosis
 - 2.1.2.12 Give two reasons why the discovery of the phenomenon of transformation in pneumococcus was of great genetic importance
 - 2.1.2.13 Define the term mutation
 - 2.1.2.14 Name the pioneer in mutation research
 - 2.1.2.15 Give an example of a lethal mutation in plants
 - 2.1.2.16 Explain how a somatic mutation differs in importance from a germ mutation
 - 2.1.2.17 Name a practical use of somatic mutation in plants
 - 2.1.2.18 Name one of the most frequent causes of mutations
 - 2.1.2.19 Know the important discoveries made by Beadle and Tatum in their work with the mold, Neurospora
 - 2.1.2.20 Understand general statements as to the effect environment can have on the way organisms develop
 - 2.1.2.21 Using the Himalayan rabbit as an example, explain how the environment can alter the action of a gene
- 2.1.3 Human genetics
 - 2.1.3.1 List three reasons why it is easier to investigate heredity in Drosophila
 - 2.1.3.2 Explain to what extent the law of chance operates in gamete formation
 - 2.1.3.3 Define the term "gene pool"
 - 2.1.3.4 Distinguish between fraternal twins and identical twins
 - 2.1.3.5 Know the purpose of using PTC test paper in testing for hereditary characteristics
 - 2.1.3.6 Show, by a diagram, how the tongue-rolling trait is inherited
 - 2.1.3.7 Define the term multiple allele
 - 2.1.3.8 List the gene combinations for the four types of blood
 - 2.1.3.9 Know an example of a sex-linked trait
 - 2.1.3.10 Use a grid to show how a sex-influenced trait such as baldness is transmitted
 - 2.1.3.11 Know an example of a sex-linked trait and give the reason it is so named
 - 2.1.3.12 Explain how a blue-eyed child may have brown-eyed parents
 - 2.1.3.13 State what is unusual about the somatic cells of individuals with Down's syndrome

- 2.1.3.14 State the relationship between heredity and intelligence
- 2.1.3.15 Name two psychoses which are thought to be hereditary
- 2.1.4 Improving genetic lines
 - 2.1.4.1 Name the outstanding pioneer in the area of plant breeding
 - 2.1.4.2 Name four objectives of plant breeding
 - 2.1.4.3 Define the terms hybridization and inbreeding
 - 2.1.4.4 List three methods of plant propagation which do not involve altering the hereditary makeup
 - 2.1.4.5 Know the reason why a farmer does not save seed from his hybrid corn to plant the following year
 - 2.1.4.6 Name a fruit which resulted from a bud mutation
 - 2.1.4.7 Define the term polyploidy and tell why it is useful in improving plants
 - 2.1.4.8 Name a type of chicken which was bred to lay a large number of eggs
 - 2.1.4.9 Name two breeds of hybrid beef cattle
- 2.2 Changes - earth and organisms
 - 2.2.1 Give the estimated age of the earth
 - 2.2.2 Name two methods used to determine the age of sedimentary rocks
 - 2.2.3 Name three ways by which remnants of the past have been preserved
 - 2.2.4 Give the meaning of the term evolution
 - 2.2.5 Name three general geological divisions of time
 - 2.2.6 Name the two types of organisms which first appeared on earth (according to fossil records)
 - 2.2.7 Describe the climatic conditions that existed on earth about 1.8×10^8 years ago
 - 2.2.8 Define the term "homologous organs"
 - 2.2.9 Name three structures of the human body which are considered to be vestigial
 - 2.2.10 List the three ideas on which Jean Baptiste Lamarck based his theory of evolution
 - 2.2.11 List five concepts included in Charles Darwin's theory of evolution
 - 2.2.12 Know the idea which DeVries contributed to the theory of evolution
 - 2.2.13 List four ways population density of an area is changed
 - 2.2.14 List two direct evolutionary results of migration
 - 2.2.15 Know an example of industrial melanism
 - 2.2.16 State the "Hardy-Weinberg principle"
 - 2.2.17 Name four barriers which may prevent interbreeding
 - 2.2.18 Describe an example of convergent evolution
 - 2.2.19 Compare adaptive radiation and convergent evolution
- 2.3 Classifying the diverse forms of life - taxonomy
 - 2.3.1 Aristotle's system
 - 2.3.1.1 Name three divisions in Aristotle's system of plant classification
 - 2.3.1.2 Name three divisions in Aristotle's system of animal classification
 - 2.3.2 Linnaeus' system
 - 2.3.2.1 Know the main aim of science according to Linnaeus
 - 2.3.2.2 List the reasons for the use of Latin as the language of taxonomy
 - 2.3.2.3 Explain the binomial system of naming organisms
 - 2.3.2.4 List the factors Linnaeus used as a basis for classification grouping
 - 2.3.2.5 Completely classify man, listing the groups in order from the largest to the smallest
 - 2.3.2.6 Name the two criteria used in defining a species
 - 2.3.3 Problems in classification
 - 2.3.3.1 Know why it is difficult to classify some of the simple forms of life such as *Euglena*
 - 2.3.3.2 Explain the reason for some biologists placing bacteria and blue-green algae in Kingdom Monera

3.0 MICROBIOLOGY

- 3.1 The viruses
 - 3.1.1 Historical development
 - 3.1.1.1 Explain why the following persons are associated with virology: Pasteur, Chamberland, Jenner, Stanley, and Iwanowski
 - 3.1.1.2 List the contribution to virology made by F. W. Twort and F. H. J'Herrelle
 - 3.1.1.3 Define virion and describe a virion
 - 3.1.1.4 Explain how the electron microscope helps us to study viruses
 - 3.1.2 Characteristics of viruses
 - 3.1.2.1 Composition and structure
 - 3.1.2.1.1 Label a diagram of a virus particle
 - 3.1.2.1.2 Describe some typical shapes of virus particles
 - 3.1.2.1.3 Compare the core of a plant virus with the cores of other viruses
 - 3.1.2.1.4 Explain the term "filterable virus"
 - 3.1.2.1.5 Give a general description of the group of microorganisms known as viruses
 - 3.1.2.1.6 Explain why viruses may be considered living organisms
 - 3.1.2.1.7 Describe the structure of a virus

- 3.1.2.2 The properties of viruses
 - 3.1.2.2.1 Explain what is meant by the virulence of a virus
 - 3.1.2.2.2 Differentiate between a virus and a living cell
 - 3.1.2.2.3 Identify two hypotheses explaining how viruses reproduce
 - 3.1.2.2.4 Name three groups of viruses on the basis of the host organism
- 3.1.2.3 The classification of viruses
 - 3.1.2.3.1 Bacterial viruses
 - 3.1.2.3.1.1 Define the terms phages, plaques, and bacteriophage
 - 3.1.2.3.1.2 Diagram the lytic cycle of a virulent phage
 - 3.1.2.3.1.3 Describe the lytic cycle of a virulent phage
 - 3.1.2.3.1.4 Describe the composition of a bacteriophage
 - 3.1.2.3.1.5 Know the economic importance of bacterial viruses
 - 3.1.2.3.2 Plant viruses
 - 3.1.2.3.2.1 Explain how plant viruses are named
 - 3.1.2.3.2.2 Describe how plant viruses may be spread
 - 3.1.2.3.2.3 List four plant virus diseases
 - 3.1.2.3.2.4 Account for the unusual coloration of a tulip that results from a virus infection
 - 3.1.2.3.3 Human and animal viruses
 - 3.1.2.3.3.1 Explain how cells are attacked during a virus infection
 - 3.1.2.3.3.2 List four well-known human diseases caused by viruses
 - 3.1.2.3.3.3 Explain problems of immunity from three human virus diseases
 - 3.1.2.3.3.4 State the arguments in support of the contention that viruses may cause human cancer
 - 3.1.2.3.3.5 Know the progress being made in treatment of virus diseases
 - 3.1.2.3.4 Mycoplasmas
 - 3.1.2.3.4.1 Compare mycoplasmas with viruses
 - 3.1.2.3.4.2 Explain why mycoplasmas are considered to be cellular organisms
- 3.2 Bacteria
 - 3.2.1 Historical development of bacteriology
 - 3.2.1.1 Give the reason why the name, Leeuwenhoek, is important to the study of bacteria and microorganisms
 - 3.2.1.2 Describe the work of Louis Pasteur in the field of bacteriology
 - 3.2.1.3 Name the father of bacteriology
 - 3.2.1.4 Compare the traditional classification of bacteria with the modern classification
 - 3.2.2 Shape and arrangement of cells
 - 3.2.2.1 Compare the terms, classification and identification, with reference to bacteria
 - 3.2.2.2 Classify bacteria into three groups, based on the shape of the cells
 - 3.2.2.3 Coccus
 - 3.2.2.3.1 Describe the arrangement of diplococcus, staphylococcus, streptococcus, tetrad, and sarcina bacterial cells
 - 3.2.2.3.2 Draw or diagram the five different arrangements of cocci bacteria
 - 3.2.2.4 Bacillus
 - 3.2.2.4.1 Describe the arrangements of diplobacillus and streptobacillus cells
 - 3.2.2.4.2 Diagram diplobacillus and streptobacillus cell
 - 3.2.2.5 Spirillum
 - 3.2.2.5.1 Draw a spirilla bacterium
 - 3.2.2.5.2 Describe the shape of spirilla bacteria
 - 3.2.3 Size of bacteria cells
 - 3.2.3.1 Express in microns the average size of bacteria
 - 3.2.3.2 Compare the size of a bacterium with that of a virus
 - 3.2.4 Bacterial structures
 - 3.2.4.1 Identify and describe the function(s) of the following structures of the bacterial cell: flagellum, fimbria, capsule, spore, cell wall, cytoplasmic membrane and granule
 - 3.2.4.2 Compare the bacterial nucleus with the discrete nucleus present in cells of higher organisms
 - 3.2.4.3 Demonstrate the various structures of bacterial cells by drawing and labeling a diagram
 - 3.2.4.4 Distinguish between a bacterial slime layer and a capsule
 - 3.2.4.5 Describe the structure and function of bacterial flagella
 - 3.2.4.6 Compare the composition and structures of a bacterial flagellum with a protozoan flagellum

- 3.2.5 Motility in bacteria
 - 3.2.5.1 Distinguish between true movement and Brownian movement of bacteria
- 3.2.6 Growth of bacteria
 - 3.2.6.1 Name four environmental requirements for the growth of bacteria
 - 3.2.6.2 List several results of microbial growth
 - 3.2.6.3 Describe the normal variation in shape of cocci and rod bacteria during the process of growth and division
 - 3.2.6.4 Explain several ways in which bacterial growth can be stopped
- 3.2.7 Bacterial nutrition
 - 3.2.7.1 Compare the nutritional requirements of autotrophic and heterotrophic bacteria
 - 3.2.7.2 Compare the nutritional requirements of bacteria with those of green plants
 - 3.2.7.3 Distinguish between chemosynthetic and photosynthetic bacteria
- 3.2.8 Bacterial respiration
 - 3.2.8.1 Compare aerobic and anaerobic respiration
 - 3.2.8.2 Name several products of the fermentation of glucose by microorganisms
 - 3.2.8.3 Describe the chemical activity of bacteria in forming methane
- 3.2.9 Bacterial reproduction
 - 3.2.9.1 Describe the processes by which bacteria multiply
 - 3.2.9.2 Describe how rapidly bacteria multiply under ideal conditions and what stops them from multiplying
 - 3.2.9.3 Explain how sexual reproduction occurs in bacteria
 - 3.2.9.4 Explain spore formation (endospores) in bacillus bacteria
- 3.2.10 Beneficial activities of bacteria
 - 3.2.10.1 Know the economic importance of bacteria
 - 3.2.10.2 Describe briefly the three major chemical changes that occur in the nitrogen cycle
 - 3.2.10.3 List four industrial uses of bacteria
 - 3.2.10.4 Describe three uses of bacteria in the dairy industry
- 3.2.11 Food spoilage and preservation
 - 3.2.11.1 List two methods of preserving foods by killing bacterial cells
 - 3.2.11.2 List three methods of preserving foods by controlling the environment and preventing growth and reproduction
- 3.2.12 Relatives of bacteria
 - 3.2.12.1 The rickettsiae
 - 3.2.12.1.1 Explain how rickettsiae are transmitted to humans
 - 3.2.12.1.2 Name several infections caused by rickettsiae
 - 3.2.12.2 The spirochetes
 - 3.2.12.2.1 Give an example of an infection caused by a spirochete
- 3.2.13 Laboratory cultivation of bacteria
 - 3.2.13.1 Name the techniques involved in handling bacteria
 - 3.2.13.2 Explain the procedures that should be followed in culturing bacteria
 - 3.2.13.3 Describe the technique for transferring bacteria from one source to another without contamination
 - 3.2.13.4 Explain how staining assists in the microscopic study of small organisms
 - 3.2.13.5 Prepare a stained smear of bacteria for microscopic examination
 - 3.2.13.6 Identify three different kinds of bacteria cultured in the laboratory
- 3.3 Infectious disease
 - 3.3.1 Historical development
 - 3.3.1.1 Name the father of bacteriological technique
 - 3.3.1.2 List Koch's postulates and explain why they were devised
 - 3.3.1.3 Name three procedures and techniques Koch devised for the laboratory study of bacteria
 - 3.3.1.4 Explain the medical contributions of Emil von Behring
 - 3.3.2 The spread of infectious organisms
 - 3.3.2.1 Explain how food- and water-borne infections enter the body
 - 3.3.2.2 Name several diseases spread by droplet infection
 - 3.3.2.3 Know two air-borne infections
 - 3.3.2.4 Name a disease associated with human carriers
 - 3.3.2.5 Name several arthropod vectors of infection and the diseases with which they are associated
 - 3.3.2.6 Define the term pre-formed toxins and give an example
 - 3.3.2.7 Distinguish between an exotoxin and an endotoxin
 - 3.3.3 Structural defenses against disease
 - 3.3.3.1 Name four structural defenses of the body
 - 3.3.3.2 Explain the way lysozymes function in body defenses
 - 3.3.4 Cellular defenses against disease
 - 3.3.4.1 Know two examples of phagocytic cells that function at the level of cellular defense
 - 3.3.4.2 Describe why fever is considered a beneficial body defense
 - 3.3.5 Antibody defenses against disease
 - 3.3.5.1 Define the terms serum, vaccine, antibody, and antigen
 - 3.3.5.2 Explain how antitoxins, agglutinins, cytolytins and precipitins act on bacteria

- 3.3.6 Immunity against disease
 - 3.3.6.1 Distinguish between natural and artificial immunity
 - 3.3.6.2 Explain how antibodies assist in the prevention of or recovery from infectious disease
 - 3.3.6.3 Explain how species immunity is established and its duration
 - 3.3.6.4 From the standpoint of origin and action, distinguish among toxins, antitoxins, toxin-antitoxins, and toxoids
 - 3.3.6.5 Explain how vaccines and serums are used in establishing immunity
- 3.3.7 Chemotherapy and antibiotic therapy
 - 3.3.7.1 Describe medical contributions made by Ehrlich and Domagk
 - 3.3.7.2 Explain how antibiotics differ from other drugs used in chemotherapy
- 3.4 The protozoans
 - 3.4.1 Characteristics of protozoa
 - 3.4.1.1 Explain the reason modern biologists changed the classification of protozoans
 - 3.4.1.2 Compare the four main groups of protozoans according to their methods of locomotion
 - 3.4.1.3 Give examples of each phylum of protozoans
 - 3.4.1.4 Define the term "pseudo"
 - 3.4.2 Ameba - phylum Sarcodina
 - 3.4.2.1 General characteristics
 - 3.4.2.1.1 Describe the structure of an Ameba
 - 3.4.2.1.2 Describe the habitat of the Ameba
 - 3.4.2.2 Life functions and reproduction
 - 3.4.2.2.1 Describe ameboid movement
 - 3.4.2.2.2 Describe the food-getting process of Ameba
 - 3.4.2.2.3 Explain the function of the contractile vacuole
 - 3.4.2.2.4 Describe reproduction in Ameba
 - 3.4.2.2.5 Know three ways in which Ameba illustrate protoplasmic sensitivity
 - 3.4.2.3 Explain the relation of amebic dysentery to sanitary conditions
 - 3.4.3 Paramecium - phylum Ciliophora (Ciliata)
 - 3.4.3.1 General characteristics
 - 3.4.3.1.1 Compare the shape of the Paramecium with that of the Ameba
 - 3.4.3.1.2 Compare the structure of the Paramecium with the Ameba
 - 3.4.3.1.3 Describe the habitat of Paramecia
 - 3.4.3.1.4 Know three ways to support the belief that Paramecium is a higher protozoan than Ameba
 - 3.4.3.1.5 Distinguish between micronuclei and macronuclei structurally and functionally
 - 3.4.3.2 Life processes
 - 3.4.3.2.1 Compare Ameba and Paramecium as to motion, food getting, excretion and reproduction
 - 3.4.3.2.2 Describe conjugation in Paramecium
 - 3.4.3.2.3 Describe the avoiding reaction in the Paramecium
 - 3.4.4 Euglena and other flagellates - phylum Mastigophora
 - 3.4.4.1 General characteristics
 - 3.4.4.1.1 Name the plant-like and animal-like characteristics of Euglena
 - 3.4.4.1.2 Describe the structure of Euglena
 - 3.4.4.1.3 Compare cell specialization in Ameba, Paramecium and Euglena
 - 3.4.4.1.4 Describe the habitat of Euglena
 - 3.4.4.1.5 Identify two non-pathogenic flagellates
 - 3.4.4.1.6 Explain the significance of colony formation in the protozoa
 - 3.4.4.2 Life functions
 - 3.4.4.2.1 Describe two kinds of movement in Euglena
 - 3.4.4.2.2 Explain the autotrophic and heterotrophic life of Euglena
 - 3.4.4.2.3 Compare Ameba, Paramecium and Euglena according to: speed of movement, food getting, digestion, absorption, respiration, excretion, sensitivity, and reproduction
 - 3.4.4.3 Trypanosomes - pathogenic protozoans
 - 3.4.4.3.1 Describe the life cycle of Trypanosomes
 - 3.4.4.3.2 Explain the nature of African sleeping sickness
 - 3.4.4.3.3 Describe the method of treatment for African sleeping sickness and tell how this disease may be controlled
 - 3.4.4.3.4 Describe the composition and structure of Trypanosomes
 - 3.4.5 Plasmodium - phylum Sporozoa
 - 3.4.5.1 Characteristics
 - 3.4.5.1.1 Describe the general characteristics of phylum Sporozoa
 - 3.4.5.1.2 Explain the basic structure of all members of phylum Sporozoa
 - 3.4.5.1.3 Compare the three major species of Plasmodium that cause malaria in human beings

- 3.4.5.2 Life functions
 - 3.4.5.2.1 Outline the life cycle of the malarial parasite, Plasmodium
 - 3.4.5.2.2 Explain how malaria disease can be controlled
- 3.4.6 The economic importance of the protozoans
 - 3.4.6.1 Explain ways in which protozoans are of great economic importance to fresh-water ponds
 - 3.4.6.2 Name two useful functions certain protozoans perform in specific animal intestines
 - 3.4.6.3 Describe the formation of limestone, chalk, and flint
- 3.5 The fungi
 - 3.5.1 Characteristics of fungi
 - 3.5.1.1 Define the term fungi
 - 3.5.1.2 Name three kinds of fungi
 - 3.5.1.3 Name three classes of fungi
 - 3.5.1.4 Explain how fungi differ from bacteria
 - 3.5.1.5 Describe the hyphae and mycelium in true fungi
 - 3.5.1.6 Know three ways in which fungi are harmful
 - 3.5.1.7 Describe certain fungi according to their economic importance
 - 3.5.1.8 Explain the statement, "All fungi are nutritionally dependent"
 - 3.5.2 Molds - Phycomycetes
 - 3.5.2.1 Vegetative and reproductive structures of molds
 - 3.5.2.1.1 Name the different kinds of hyphae that make up a bread mold plant
 - 3.5.2.1.2 Describe the reproductive processes in bread mold
 - 3.5.2.1.3 Spell the scientific name of bread mold correctly
 - 3.5.2.1.4 Describe asexual reproduction in Saprolegnia
 - 3.5.2.1.5 Indicate procedures or conditions that might be expected to prevent growth of molds on book bindings, citrus fruits, jams and jellies
 - 3.5.2.1.6 Explain the cultural conditions that are best suited for growth of molds
 - 3.5.2.2 Blights and downy mildews - Phycomycetes
 - 3.5.2.2.1 Explain the growth and reproductive pattern of the late blight fungus
 - 3.5.2.2.2 Compare the downy mildews with the potato blight fungus
 - 3.5.2.2.3 Name three plants that are attacked by downy mildews
 - 3.5.2.2.4 List the methods of control for downy mildews and blights
 - 3.5.2.3 Blue-green molds and powdery mildews
 - 3.5.2.3.1 Compare molds of the genus, Penicillium with molds of the genus, Aspergillus
 - 3.5.2.3.2 Name useful products manufactured from blue-green molds
 - 3.5.2.3.3 Describe the habitat of the blue-green molds
 - 3.5.2.3.4 Explain laboratory techniques used in culturing Penicillium notatum
 - 3.5.2.3.5 Compare the hyphae produced by bread mold with hyphae produced by Penicillium
 - 3.5.2.3.6 Compare powdery mildews with downy mildews as to structure, composition, food getting and reproduction
 - 3.5.2.3.7 Name five plants that are host of these powdery mildews
 - 3.5.2.4 Yeasts - Ascomycetes
 - 3.5.2.4.1 Explain why yeasts are classified with ascomycetes
 - 3.5.2.4.2 Know the similarities between yeasts and molds
 - 3.5.2.4.3 Describe budding in yeasts
 - 3.5.2.4.4 Describe the nutrient and cultural conditions that favor yeast growth and spoilage
 - 3.5.2.4.5 Explain the difference the absence of air makes in the growth and activity of yeast
 - 3.5.2.4.6 Draw several yeast cells that were examined under high power; label bud, vacuole, cell wall, and nucleus
 - 3.5.2.4.7 Explain how products of yeast fermentation are used commercially
 - 3.5.2.4.8 Know the reasons why yeast preparations are valuable in treating acne and other skin disorders
 - 3.5.2.5 Relatives of yeasts
 - 3.5.2.5.1 Name two relatives of yeasts
 - 3.5.2.5.2 Describe the habitats of cup fungi and the morel
 - 3.5.2.5.3 Name two diseases caused by parasitic ascomycetes
- 3.5.2.6 Basidiomycetes
 - 3.5.2.6.1 Describe the general features of the class, Basidiomycetes
 - 3.5.2.6.2 Name the four groups of fungi that compose the class, Basidiomycetes
 - 3.5.2.6.3 Rust fungi
 - 3.5.2.6.3.1 Name the four kinds of spores produced by wheat rust
 - 3.5.2.6.3.2 Name three diseases caused by rust fungi

- 3.5.2.6.3.3 Describe the life cycle of wheat rust
- 3.5.2.6.3.4 Explain two methods for control of the organism causing wheat rust
- 3.5.2.6.4 Smut fungi
 - 3.5.2.6.4.1 Name five plants that may be attacked by smuts
 - 3.5.2.6.4.2 Compare the life cycle of wheat rust with the life cycle of corn smut
 - 3.5.2.6.4.3 Explain how the farmer identifies corn infected with smut
 - 3.5.2.6.4.4 Know ways used to control corn smut
- 3.5.2.6.5 Mushrooms and bracket fungi
 - 3.5.2.6.5.1 Describe the development of a mushroom
 - 3.5.2.6.5.2 Describe the various habitats of mushrooms
 - 3.5.2.6.5.3 Explain the most acceptable method used in determining poisonous and edible mushrooms
 - 3.5.2.6.5.4 Describe the structure of a mushroom reproductive body
 - 3.5.2.6.5.5 Identify bracket fungi
 - 3.5.2.6.5.6 Know the life cycle of the bracket fungi
- 3.5.2.6.6 Puffballs
 - 3.5.2.6.6.1 Compare puffballs and mushrooms structurally
 - 3.5.2.6.6.2 Explain why puffballs are given that name
- 3.5.2.6.7 Imperfect fungi - Deuteromycetes
 - 3.5.2.6.7.1 Describe the general characteristics of imperfect fungi
 - 3.5.2.6.7.2 Name two human infections caused by imperfect fungi
 - 3.5.2.6.7.3 Know two preventive measures used to control diseases caused by imperfect fungi among plants and humans
 - 3.5.2.6.7.4 Explain the important parasitic relationship of the imperfect fungi in man, animal and plants
- 3.5.2.6.8 Slime molds - phylum Myxomycetes
 - 3.5.2.6.8.1 Explain why slime molds may be considered a plant by some biologists and an animal by others
 - 3.5.2.6.8.2 Describe the habitat of slime molds
 - 3.5.2.6.8.3 Describe the plasmodium of a slime mold
- 3.6 Algae
 - 3.6.1 General characteristics of algae
 - 3.6.1.1 Describe the various habitats of algae
 - 3.6.1.2 Compare the differences among algae, bacteria and fungi
 - 3.6.1.3 Know the three forms of algae
 - 3.6.1.4 Describe four cell groupings in colonial algae
 - 3.6.1.5 Explain why most algae grow in shallow water or float near the surface in deep water
 - 3.6.2 Methods of reproduction in algae
 - 3.6.2.1 Explain the asexual and sexual reproductive processes of algae
 - 3.6.2.2 Compare the reproductive processes of algae with those of fungi and bacteria
 - 3.6.2.3 Distinguish between isogametes and heterogametes
 - 3.6.3 Classification of algae
 - 3.6.3.1 Know four characteristics used in classifying algae
 - 3.6.3.2 Describe the distinguishing features of three phyla of algae
 - 3.6.3.3 Name three pigments found in algae
 - 3.6.4 Blue-green algae - Cyanophyta
 - 3.6.4.1 List the various habitats where members of the Cyanophyta are found
 - 3.6.4.2 Compare the cellular structure of blue-green algae with other algae
 - 3.6.4.3 Describe the composition of a ball of Nostoc
 - 3.6.4.4 Name four common blue-green algae
 - 3.6.4.5 Distinguish between a filament of Anabaena and a filament of Nostoc
 - 3.6.4.6 Explain why Oscillatoria is an appropriate name for this blue-green alga
 - 3.6.4.7 Explain how Anabaena differs from Nostoc in structure and in method of reproduction
 - 3.6.4.8 Name three pigments found in blue-green algae
 - 3.6.4.9 Explain the significance of blue-green algae in determining the name of the Red Sea
 - 3.6.4.10 Know the ways in which Gloeocapsa is similar to bacteria
 - 3.6.5 Green algae - Chlorophyta
 - 3.6.5.1 Compare the structure of green algae with higher plants
 - 3.6.5.2 Know the habitats of green algae
 - 3.6.5.3 Name two pigments found in green algae
 - 3.6.5.4 Name the two kinds of sexual reproduction in chlorophytes

- 3.6.5.5 Protococcus
- 3.6.5.5.1 Describe the habitat of Protococcus
 - 3.6.5.5.2 Know the shape and structure of the cells of Protococcus
 - 3.6.5.5.3 In terms of fission, explain why Protococcus forms cell clusters rather than filaments
 - 3.6.5.5.4 Explain why Protococcus is found mostly on the north side of tree trunks
- 3.6.5.6 Chlorella
- 3.6.5.6.1 Identify Chlorella
 - 3.6.5.6.2 Describe the shape and structure of Chlorella
 - 3.6.5.6.3 Explain why Chlorella is likely to become more important to man in the future
- 3.6.5.7 Spirogyra
- 3.6.5.7.1 Distinguish Spirogyra from other filamentous green algae on the basis of its microscopic appearance
 - 3.6.5.7.2 Describe the shape, structure and composition of Spirogyra
 - 3.6.5.7.3 Explain the ways in which Nostoc differs from Spirogyra
 - 3.6.5.7.4 Describe conjugation in Spirogyra
 - 3.6.5.7.5 Explain how zygospores of Spirogyra enable the alga to survive from season to season
 - 3.6.5.7.6 Know the reason why fission adds to the length of the filaments in Spirogyra
- 3.6.5.8 Ulothrix
- 3.6.5.8.1 Describe the life cycle of Ulothrix
 - 3.6.5.8.2 Compare sexual reproduction as it occurs in Ulothrix and Spirogyra
 - 3.6.5.8.3 Explain the importance of the "holdfast" cell in Ulothrix
 - 3.6.5.8.4 Name the most conspicuous stage in the reproductive process of Ulothrix
- 3.6.5.9 Oedogonium
- 3.6.5.9.1 Describe the habitats of Oedogonium
 - 3.6.5.9.2 Explain the formation and union of gametes in Oedogonium
 - 3.6.5.9.3 Define the term "alternation of generation"
 - 3.6.5.9.4 Describe alternation of generation in Oedogonium or Ulothrix
 - 3.6.5.9.5 Explain why Oedogonium is considered one of the more advanced algae
 - 3.6.5.9.6 Compare the structure of Oedogonium and Ulothrix
- 3.6.5.10 Desmids
- 3.6.5.10.1 Explain the characteristics of desmids that distinguish them from other unicellular algae
 - 3.6.5.10.2 Describe the cell structure of a desmid
 - 3.6.5.10.3 Define the term plankton
 - 3.6.5.10.4 Describe the habitat of desmids
- 3.6.5.11 Diatoms - phylum Chrysophyta
- 3.6.5.11.1 Distinguish between desmids and diatoms
 - 3.6.5.11.2 Give a general description of diatoms
 - 3.6.5.11.3 Describe the various habitats of diatoms
 - 3.6.5.11.4 Describe the wall conditions in diatoms
 - 3.6.5.11.5 Describe the shells of diatoms
 - 3.6.5.11.6 Explain the most common method of reproduction in diatoms
 - 3.6.5.11.7 Know the composition of diatomaceous earth
 - 3.6.5.11.8 State several uses of diatomaceous earth
- 3.6.5.12 Dinoflagellates - phylum Pyrrophyta
- 3.6.5.12.1 Describe the physical appearance of marine dinoflagellates
 - 3.6.5.12.2 Explain how dinoflagellates can be distinguished from other flagellated organisms
 - 3.6.5.12.3 Identify the algae responsible for the "red tides"
 - 3.6.5.12.4 Account for the destruction of fish during the "red tides"
 - 3.6.5.12.5 Explain why it is difficult to control the red tide condition
 - 3.6.5.12.6 Name the pigments in dinoflagellates
 - 3.6.5.12.7 Describe the places where dinoflagellates are found
- 3.6.5.13 The brown algae - phylum Phaeophyta
- 3.6.5.13.1 Name the two phyla of algae called seaweeds
 - 3.6.5.13.2 Know where brown algae are found
 - 3.6.5.13.3 Name three types of brown algae
 - 3.6.5.13.4 Name the pigments located in the cells of brown algae
 - 3.6.5.13.5 Describe the form and size of brown algae
 - 3.6.5.13.6 Explain the economic importance of brown algae
 - 3.6.5.13.7 Name the largest brown algae
- 3.6.5.14 The red algae - phylum Rhodophyta
- 3.6.5.14.1 Name the identifying feature of red algae
 - 3.6.5.14.2 Know three ways in which red algae differ from brown algae
 - 3.6.5.14.3 Name the pigments found in red algae
 - 3.6.5.14.4 Compare the habitat of red algae with most brown algae

- 3.6.5.14.5 Compare the vegetative bodies of red algae with brown algae
- 3.6.5.14.6 Summarize the special characteristics of the green, brown and red algae groups
- 3.6.5.14.7 Compare pigments, food storage compounds and cell wall compounds of green, brown and red algae groups
- 3.6.5.15 The economic importance of the algae
 - 3.6.5.15.1 Know the economic importance of red algae
 - 3.6.5.15.2 Name four commercial uses of algae
 - 3.6.5.15.3 Explain the progress being made in the use of algae in space flights
 - 3.6.5.15.4 Describe how man secures the vitamins that algae manufacture
- 3.6.5.16 Lichens
 - 3.6.5.16.1 Define the term symbiosis
 - 3.6.5.16.2 Explain how a lichen illustrates symbiosis
 - 3.6.5.16.3 Describe the structure of a lichen
 - 3.6.5.16.4 Know the three common forms of lichens
 - 3.6.5.16.5 Name three ways in which lichens are considered to be important plants
 - 3.6.5.16.6 Identify the fungi and algae involved in the composition of the different lichens
 - 3.6.5.16.7 Explain the reproductive process in lichens

4.0 MULTICELLULAR PLANTS

- 4.1 The mosses and liverworts
 - 4.1.1 Name the classes of bryophytes and give their identifying features
 - 4.1.2 Describe the habitats of bryophytes
 - 4.1.3 Life cycle of a moss
 - 4.1.3.1 Explain how the sporophyte structures of the moss arise
 - 4.1.3.2 Name and describe the parts of the mature sporophyte
 - 4.1.3.3 Identify the reproductive structures of the moss plant using a living specimen
 - 4.1.3.4 Identify the stage in the life cycle of moss where meiosis occurs
 - 4.1.3.5 Name the stage in the life cycle of moss that provides evidence of its algal evolutionary trend
 - 4.1.4 Name several organisms that are incorrectly called mosses
 - 4.1.5 Explain the economic importance of mosses
 - 4.1.6 Differentiate between the patterns of growth in mosses and liverworts
 - 4.1.7 Name a common liverwort
 - 4.1.8 Describe the gamete producing structures of Marchantia
- 4.2 The ferns - tracheophytes
 - 4.2.1 Know the structural characteristics that are common to ferns and seed plants
 - 4.2.2 Describe the sporophyte in the life cycle of a fern
 - 4.2.3 Name the fern relatives or allies
 - 4.2.4 Explain the sorus condition as found in the common fern
 - 4.2.5 Describe the parts of a mature sporangium
 - 4.2.6 Describe spore dispersal in the ferns
 - 4.2.7 Compare the growth of the young fern gametophyte to the filamentous algae and to the protonema of the moss
 - 4.2.8 Identify all structures in a diagram of the life cycle of the fern
 - 4.2.9 List several habitats of ferns
- 4.3 The seed plants
 - 4.3.1 Name the group of extinct plants which was the probable evolutionary link between ferns and modern seed plants
 - 4.3.2 Name two characteristics, external or internal, that can be used to separate the gymnosperms from the angiosperms
 - 4.3.3 The gymnosperms
 - 4.3.3.1 Distinguish between the order Cycadales and the order Ginkgoales
 - 4.3.3.2 Name the parts of the world where cycads can be found
 - 4.3.3.3 Know the common names of five members of Coniferales and indicate, for each, one characteristic that separates each from the others
 - 4.3.3.4 Know the economic importance of conifers
 - 4.3.3.5 Describe two kinds of cones borne by the conifers in their reproductive cycle
 - 4.3.3.6 Locate two coniferous forests of North America
 - 4.3.3.7 Describe the structural characteristics of gymnosperms
 - 4.3.4 The angiosperms - the flowering plants
 - 4.3.4.1 Name the two large subclasses of angiosperms
 - 4.3.4.2 Name two characteristics that separate the monocotyledons from the dicotyledons
 - 4.3.4.3 Know the principle function of each of the vegetative organs of a flowering plant
 - 4.3.4.4 Identify the reproductive organs of a flowering plant
 - 4.3.4.5 Distinguish between a meristematic tissue and a permanent tissue
 - 4.3.4.6 Recognize three permanent tissues: parenchyma, collenchyma, and sclerenchyma

- 4.3.4.7 Describe the parenchyma cells found in the elodea plant
- 4.3.4.8 Identify the three organs which compose the plant body of a vascular plant
- 4.3.4.9 Name several kinds of strengthening tissues found in the roots, stems, and leaves of a vascular plant
- 4.3.4.10 Distinguish between woody and herbaceous stems
- 4.3.4.11 On the basis of the duration of the plant body, classify flowering plants into three groups
- 4.4 The leaf and its function
 - 4.4.1 The structure of a leaf
 - 4.4.1.1 Identify four general structures of a leaf
 - 4.4.1.2 Name four characteristics of a leaf that are useful in the identification of plant species
 - 4.4.1.3 Name two functions of veins
 - 4.4.1.4 Compare the venation in monocotyledons and dicotyledons
 - 4.4.1.5 Distinguish between a simple leaf and a compound leaf
 - 4.4.1.6 Describe two arrangements of leaflets in the compound leaves
 - 4.4.2 The tissues of a leaf
 - 4.4.2.1 Name the three tissues of a leaf
 - 4.4.2.2 Describe the functions of leaf tissues
 - 4.4.2.3 Identify the parts of a cross section of a leaf
 - 4.4.2.4 The structure of the epidermis
 - 4.4.2.4.1 Explain the main function of the leaf epidermis.
 - 4.4.2.4.2 Describe the structure of guard cells
 - 4.4.2.4.3 Explain the relation between guard cells and stomates
 - 4.4.2.4.4 Describe the epidermal hairs found on the surface of some leaves
 - 4.4.2.4.5 Explain the importance of the cuticle formed on the epidermis of many leaves
 - 4.4.2.5 The mesophyll
 - 4.4.2.5.1 With the common type of leaf in mind, name and describe the tissues composing the mesophyll
 - 4.4.2.5.2 Define the term mesophyll
 - 4.4.2.6 Structure of veins
 - 4.4.2.6.1 Define the term fibrovascular bundles
 - 4.4.2.6.2 Name the tissues composing a large vein and indicate the function of each
 - 4.4.2.6.3 Describe small and medium-sized veins
 - 4.4.2.6.4 Explain the function of sclerenchyma fibers
 - 4.4.2.6.5 Differentiate between leaf traces, leaf scars, bundle scars and leaf gap
 - 4.4.3 Contrast photosynthesis and respiration with regard to glucose, oxygen and carbon dioxide relations, and energy changes that occur
 - 4.4.4 Explain how foods are translocated from leaves
 - 4.4.5 Name the substance involved in photosynthesis that is believed to be the main cause of the opening and closing of stomates
 - 4.4.6 Explain why transpiration is an essential function of the leaf
 - 4.4.7 Identify two types of leaves and four leaf arrangements
 - 4.4.8 Explain why leaves turn yellow, orange, or red with the coming of autumn
 - 4.4.9 Describe the mechanism involved in the shedding of leaves in the fall
 - 4.4.10 Leaf modifications
 - 4.4.10.1 Distinguish between spines and tendrils
 - 4.4.10.2 Describe the leaves of three common insectivorous plants
 - 4.4.10.3 Compare the structure of succulent leaves with broad and thin or needle-shaped leaves
 - 4.4.11 Explain why leaf replacement is necessary in the life of a plant
 - 4.4.12 Explain the origin of the leaf
- 4.5 Roots
 - 4.5.1 The origin of the roots
 - 4.5.1.1 From the standpoint of origin, distinguish between primary and secondary roots
 - 4.5.1.2 Name three environmental factors that influence the growth of roots
 - 4.5.2 Types of roots and root systems
 - 4.5.2.1 Describe the general form of a tap root system and a fibrous root system
 - 4.5.2.2 Compare and contrast the fibrous root system of the grass with the tap root system of dandelion
 - 4.5.2.3 Know three functions of roots
 - 4.5.3 The root tip and terminal growth of the root
 - 4.5.3.1 Name the four major regions of the root tip
 - 4.5.3.2 Locate the four regions of the root tip and describe the activities that occur in each
 - 4.5.3.3 Explain the difference between root hairs and root cap
 - 4.5.3.4 Root hairs
 - 4.5.3.4.1 Describe the location of root hairs on the root

- 4.5.3.4.2 Know the function of root hairs in the life of the plant
 - 4.5.3.4.3 Describe the structure of a single root hair
 - 4.5.4 Primary tissues of the root
 - 4.5.4.1 Name and describe the primary tissues of a root as they occur from outside to inside
 - 4.5.4.2 Identify each primary tissue with a specialized function
 - 4.5.5 Secondary growth in roots
 - 4.5.5.1 Describe the formation of secondary tissues by the vascular cambium
 - 4.5.5.2 Locate the vascular cambium in a root
 - 4.5.5.3 Describe the function of the secondary tissues
 - 4.5.6 Modified roots
 - 4.5.6.1 Identify four modifications of roots and describe the adaptive role of each modification
 - 4.5.6.2 Name three examples of adventitious roots
 - 4.5.6.3 Explain the importance of adventitious roots to various kinds of plants
- 4.6 Stems
 - 4.6.1 External structure of a woody stem
 - 4.6.1.1 Label the external structures of a woody stem
 - 4.6.1.2 Distinguish among terminal, axillary and accessory buds
 - 4.6.1.3 Identify the external structures of a twig of a tree
 - 4.6.1.4 Know the differences between a stem and a root
 - 4.6.1.5 Define the terms: nodes, internodes and lenticels
 - 4.6.1.6 Structure of a bud
 - 4.6.1.6.1 Describe the shoot apex
 - 4.6.1.6.2 Classify buds into three types on the basis of their content
 - 4.6.2 The growth of stems
 - 4.6.2.1 Describe how a stem grows in length
 - 4.6.2.2 Describe two branching habits of trees and explain the relation of each to apical dominance
 - 4.6.3 Primary and secondary growth of woody stems
 - 4.6.3.1 Describe the primary growth of woody stems
 - 4.6.3.2 Name the primary tissues of a stem as they occur from outside to inside
 - 4.6.3.3 Describe the nature and functioning of the vascular cambium in secondary growth
 - 4.6.3.4 Describe the results of secondary growth
 - 4.6.4 Regions of a woody stem
 - 4.6.4.1 Bark
 - 4.6.4.1.1 Name the bark tissues of a woody stem
 - 4.6.4.1.2 Know two ways of identifying cork cells in a woody stem
 - 4.6.4.1.3 Describe the activities of cork cambium
 - 4.6.4.2 Wood
 - 4.6.4.2.1 Describe the tissue composing wood
 - 4.6.4.2.2 Distinguish between a vascular ray and a pith ray
 - 4.6.4.2.3 Account for the difference in appearance of heartwood and sapwood
 - 4.6.4.2.4 Explain the formation of annual rings in wood
 - 4.6.4.3 Pith region of a stem
 - 4.6.4.3.1 Describe the cell type and activity of the pith region of a woody stem
 - 4.6.4.3.2 Explain why the pith region in a woody stem does not increase in amount as the tree grows in diameter
 - 4.6.4.4 Vascular cambium
 - 4.6.4.4.1 Compare the vascular cambium in the root with the vascular cambium in the woody stem
 - 4.6.4.4.2 Explain why the wood area of a tree is always greater than its bark thickness
 - 4.6.5 Herbaceous dicotyledonous stems
 - 4.6.5.1 Describe the arrangement of fibrovascular bundles in the stems of herbaceous dicotyledons
 - 4.6.5.2 Describe the cortex region of the stems of herbaceous dicotyledon
 - 4.6.5.3 Compare the difference between a herbaceous dicotyledon stem and the woody stem
 - 4.6.5.4 Name four herbaceous dicot plants
 - 4.6.5.5 Know three structural characteristics of dicotyledonous stems that distinguish them from monocotyledonous stems
 - 4.6.6 Monocotyledonous stems
 - 4.6.6.1 Name a common monocotyledonous plant
 - 4.6.6.2 Compare and contrast a herbaceous dicotyledonous (bean) stem and fibrovascular bundles with those of the herbaceous monocotyledonous (corn) stem and bundles, using microscopic sections
 - 4.6.7 Modified stems
 - 4.6.7.1 Name five forms of underground stems
 - 4.6.7.2 Describe several functions of underground stems

- 4.6.7.3 Describe the structural characteristics of five forms of underground stems
- 4.7 Water relations in plants
 - 4.7.1 Plants and water
 - 4.7.1.1 Know three plant processes that require water
 - 4.7.1.2 Define the term hydrolysis
 - 4.7.2 Soil and soil water
 - 4.7.2.1 Describe the components of soil in relation to soil texture
 - 4.7.2.2 Classify three soil types on the basis of texture
 - 4.7.2.3 Explain why pore spaces in soil are important
 - 4.7.2.4 Differentiate among gravitational, capillary, and hygroscopic soil water
 - 4.7.3 Absorption of water by the root
 - 4.7.3.1 Name the forces involved in active and passive water absorption by root hairs and epidermal cells
 - 4.7.3.2 Account for most of the water intake of land plants
 - 4.7.4 Water lost from a root
 - 4.7.4.1 Explain the condition in which water moves from the root into the surrounding areas in terms of a hypotonic solution
 - 4.7.4.2 Describe the term halophytes
 - 4.7.5 The absorption of minerals
 - 4.7.5.1 Differentiate between active absorption and active transport
 - 4.7.5.2 Explain how minerals are absorbed by root cells
 - 4.7.6 Translocation of water and minerals
 - 4.7.6.1 Define the term translocation
 - 4.7.6.2 Name three factors believed to be involved in translocation of water through xylem vessels and tracheids of a stem
 - 4.7.6.3 Describe the usual direction of water and mineral translocation through roots and stems
 - 4.7.7 Translocation of foods
 - 4.7.7.1 Describe the usual direction of food translocation through stems and roots
 - 4.7.7.2 Explain how girdling a tree demonstrates that foods are conducted through phloem sieve tubes
 - 4.7.8 Turgidity in plant cells
 - 4.7.8.1 Define the terms "turgor pressure" and "turgidity"
 - 4.7.8.2 Explain the cause of temporary wilting or permanent wilting due to lack of turgor pressure
 - 4.7.9 Guttation
 - 4.7.9.1 Define the term guttation
 - 4.7.9.2 Name the force in a plant that is believed to be responsible for guttation of water
 - 4.7.9.3 Compare guttation of water with dew
- 4.8 Plant growth and responses
 - 4.8.1 External influences on plant growth
 - 4.8.1.1 Light influences on plant growth
 - 4.8.1.1.1 Describe the stem and leaves of a young plant grown in the dark
 - 4.8.1.1.2 Know possible reasons for the fact that shade leaves of a plant are larger than sun leaves of the same plant
 - 4.8.1.1.3 Define the term photoperiodism
 - 4.8.1.1.4 Explain how flowering plants may be classified according to photoperiodism
 - 4.8.1.1.5 Name three short-day plants and three long-day plants
 - 4.8.1.2 The influence of temperature on growth
 - 4.8.1.2.1 Name the optimum temperature range for growth of the majority of plants
 - 4.8.2 Dormancy in plants
 - 4.8.2.1 Explain how woody plants, herbaceous perennials and annuals, survive periods of dormancy
 - 4.8.2.2 Name two external conditions that "break" dormancy in seed plants
 - 4.8.3 Plant hormones
 - 4.8.3.1 Explain the difference between plant hormones and other secretions within the plant according to where they are formed and their activity
 - 4.8.3.2 Explain the difference between a growth hormone and a growth regulator
 - 4.8.3.3 The role of auxins
 - 4.8.3.3.1 Name the auxin which is produced in largest amounts in seed plants
 - 4.8.3.3.2 Describe the reaction of auxins to different plant tissues (stem and root)
 - 4.8.3.3.3 Explain the use of the coleoptile test
 - 4.8.3.4 Gibberellins and kinins
 - 4.8.3.4.1 Explain the similarity of gibberellins and auxins in regulating plant growth
 - 4.8.3.4.2 Describe the ways in which auxins, gibberellins and kinins influence plant growth

- 4.8.4 Tropisms, growth responses to environmental stimuli
 - 4.8.4.1 Name five tropisms
 - 4.8.4.2 Identify five tropisms with an external response
 - 4.8.4.3 Distinguish between a positive and a negative response
- 4.8.5 Nastic movements in plants
 - 4.8.5.1 Differentiate between nastic movements and tropic responses
 - 4.8.5.2 Name several examples of nastic movements
- 4.9 Plant reproduction
 - 4.9.1 Vegetative reproduction (asexual)
 - 4.9.1.1 Compare vegetative reproduction by runners as in the strawberry and tip layering as in the raspberry plant
 - 4.9.1.2 Describe the use of hormone preparations in promoting the growth of adventitious roots on cuttings
 - 4.9.1.3 Describe three methods of vegetative propagation by layering
 - 4.9.1.4 Differentiate between the stock and scion portion of a graft
 - 4.9.1.5 Name three types of grafts
 - 4.9.1.6 Identify an example of budding as a method of plant propagation
 - 4.9.2 The flower (sexual reproduction)
 - 4.9.2.1 Identify four sets or parts of a complete flower
 - 4.9.2.2 Name two parts of a flower that are concerned directly with reproduction
 - 4.9.2.3 Describe the parts of the stamen
 - 4.9.2.4 Identify and describe the parts of the pistil
 - 4.9.2.5 Variation in flower structure
 - 4.9.2.5.1 Compare the flower structure of monocots and dicots
 - 4.9.2.5.2 Name three species of flowers bearing pistils on one plant and stamens on another plant
 - 4.9.2.5.3 Describe the structure of the sunflower or daisy flower
 - 4.9.2.6 The anther and pollen formation
 - 4.9.2.6.1 Describe the development of mature pollen grains
 - 4.9.2.6.2 Differentiate between microspore mother cells and microspores in chromosome number
 - 4.9.2.7 Development of the ovule
 - 4.9.2.7.1 Describe the formation of megaspores in an ovule
 - 4.9.2.7.2 Identify the eight nuclei present in the embryo sac at the time of fertilization
 - 4.9.2.8 Pollination
 - 4.9.2.8.1 Define the term pollination
 - 4.9.2.8.2 Explain the difference between self-pollination and cross-pollination
 - 4.9.2.8.3 Name three agents of pollination
 - 4.9.2.8.4 Describe the growth of the pollen tube after pollination
 - 4.9.2.8.5 Name the parts of the seed produced from the zygote and from the endosperm nucleus
 - 4.9.2.9 Compare the evolutionary trend of the gametophyte and the sporophyte in flowering plants with the gametophyte and sporophyte in mosses and ferns
 - 4.9.3 The fruit
 - 4.9.3.1 Know the biological meaning of the term fruit
 - 4.9.3.2 Explain how fertilization of the flower is related to the development of fruit
 - 4.9.3.3 Differentiate between a dehiscent fruit and an indehiscent fruit
 - 4.9.3.4 Explain the way in which a multiple fruit differs from all of the other kinds of fruits
 - 4.9.3.5 Name five types of fleshy fruits; give an example of each
 - 4.9.3.6 Describe three ways in which fruits are dispersed
 - 4.9.3.7 Compare the structural characteristics of two fleshy fruits and two dry fruits (open when ripe); give an example
 - 4.9.4 The seeds
 - 4.9.4.1 Define the term seed
 - 4.9.4.2 Describe the basic composition and structure of the seed
 - 4.9.4.3 Compare the monocot and dicot plants according to the number of cotyledons in their seeds and the kind of food stored in the cotyledons
 - 4.9.4.4 Structure of a bean (dicot)
 - 4.9.4.4.1 Identify the external structure of a bean seed
 - 4.9.4.4.2 Identify and locate the parts of an embryo plant as illustrated in the bean
 - 4.9.4.5 Structure of the corn kernel (monocot)
 - 4.9.4.5.1 Identify the external structure of a kernel of corn
 - 4.9.4.5.2 Compare and contrast the structure of dicot (bean) seed with the structure of a monocot (corn) seed
 - 4.9.4.6 Dormancy in seeds
 - 4.9.4.6.1 Define the terms dormancy and viability
 - 4.9.4.6.2 Describe the conditions of dormancy and viability as they relate to germination

- 4.9.4.7 Conditions for germination
 - 4.9.4.7.1 Name three external conditions necessary for seed germination
 - 4.9.4.7.2 Explain how the functioning of the cotyledons differ in the dicotyledons and the monocotyledons during germination
- 4.9.4.8 Growth of the seedling
 - 4.9.4.8.1 Compare the germination of seeds lying on the surface with seeds completely buried.
 - 4.9.4.8.2 Explain how enzymes control the germination of seed
 - 4.9.4.8.3 Name the stages that occur in the germination of a bean (dicot) seed and a kernel of corn (monocot)
 - 4.9.4.8.4 Compare the early growth of the bean seedling and corn seedling

5.0 BIOLOGY OF INVERTEBRATES

5.1 Porifera (sponges)

- 5.1.1 Cell specialization
 - 5.1.1.1 Name the advantages of cell specialization
 - 5.1.1.2 Explain how the multicellular condition permits efficient division of labor
- 5.1.2 Characteristics of Porifera
 - 5.1.2.1 Know the characteristic the phylum name of the sponges describes
 - 5.1.2.2 Describe the organization of a simple sponge
 - 5.1.2.3 Describe the environments in which the different types of sponges are found
- 5.1.3 Structures and functions of sponges
 - 5.1.3.1 Describe the three kinds of internal skeletons that occur in sponges
 - 5.1.3.2 Name the structure and function of the following types of sponge cells: epithelial, collar, and mesenchyme
 - 5.1.3.3 Describe how sponges obtain food
 - 5.1.3.4 Explain how digestion, respiration and reproduction are accomplished in a sponge
 - 5.1.3.5 Know the significance of the great regenerative capacities in the sponge

5.2 The Coelenterates

- 5.2.1 General characteristics
 - 5.2.1.1 Describe the chief coelenterate features
 - 5.2.1.2 Explain why coelenterates are more specialized than sponges
 - 5.2.1.3 Name and describe the three classes of coelenterates
 - 5.2.1.4 Describe the habitats of coelenterates
- 5.2.2 Hydra
 - 5.2.2.1 Structures and life processes
 - 5.2.2.1.1 Describe the external and internal structure of the Hydra
 - 5.2.2.1.2 Briefly define the following terms: nematocyst, tissue level of organization, regeneration
 - 5.2.2.1.3 Explain how hydras carry out digestion, respiration, and excretion
 - 5.2.2.1.4 Explain how a Hydra moves
 - 5.2.2.1.5 Describe the nervous system in the Hydra
 - 5.2.2.1.6 Compare the feeding methods of a sponge and a Hydra
 - 5.2.2.1.7 Describe reproduction in the Hydra
 - 5.2.2.1.8 Contrast regeneration in the sponge and Hydra
- 5.2.3 Aurelia
 - 5.2.3.1 General characteristics
 - 5.2.3.1.1 Outline the life cycle of Aurelia
 - 5.2.3.1.2 Compare the structure of a Hydra with medusa of Aurelia
- 5.2.4 Coral
 - 5.2.4.1 General characteristics
 - 5.2.4.1.1 Describe the structure and size of a coral's body
 - 5.2.4.1.2 Describe the formation of a coral reef
 - 5.2.4.1.3 Name the three types of coral reefs
 - 5.2.4.1.4 Explain the economic importance of corals
- 5.2.5 Portuguese man-of-war
 - 5.2.5.1 General characteristics
 - 5.2.5.1.1 Describe the habitat of Portuguese man-of-war
 - 5.2.5.1.2 Describe the structure of Portuguese man-of-war
 - 5.2.5.1.3 Explain why cell specialization is considered to be more complex in Portuguese man-of-war than in other coelenterates

5.3 Platyhelminthes

- 5.3.1 Describe four ways a flatworm represents an advancement over the coelenterates
- 5.3.2 Explain the differences between parasitic and free-living worms
- 5.3.3 Explain what might have been the origin of flatworms in evolution
- 5.3.4 Name the significance of the three layers of cells found in flatworms
- 5.3.5 Explain the meaning of mesoderm and mesoglea
- 5.3.6 Name the three classes of the flatworm phylum; give an example of each

- 5.3.7 The planarians - Class Turbellaria
 - 5.3.7.1 Describe the habitat of the planarians
 - 5.3.7.2 Identify the body structures of the planarians
 - 5.3.7.3 Differentiate between endoderm, mesoderm, and ectoderm in the planarians
 - 5.3.7.4 Describe several of the regeneration experiments that have been performed on planarian worms
 - 5.3.7.5 Describe the dorsal and ventral surface of the Planaria
 - 5.3.7.6 Describe movement of the Planaria
 - 5.3.7.7 Describe the type of symmetry exhibited by a Planaria
 - 5.3.7.8 Describe reproduction in planarians
 - 5.3.7.9 Locate the mouth and pharynx of the Planaria
 - 5.3.7.10 Describe five organ systems of planarians
- 5.3.8 The flukes - Class Trematoda
 - 5.3.8.1 Trace the life cycle of a sheep liver fluke
 - 5.3.8.2 Describe the structural characteristics of the liver fluke
 - 5.3.8.3 Name several parasitic adaptations found in the flukes
 - 5.3.8.4 Explain how infection in man caused by the fluke may be prevented
- 5.3.9 The tapeworms - Class Cestoda
 - 5.3.9.1 Explain how the flukes and tapeworms differ from the planarians
 - 5.3.9.2 Outline the life cycle of the beef tapeworm
 - 5.3.9.3 Differentiate between a scolex and a proglottid
 - 5.3.9.4 Explain why the proglottids near the posterior of the tapeworm are larger than those near the head
 - 5.3.9.5 Describe the body structure of an adult tapeworm
 - 5.3.9.6 Describe several adaptations of the tapeworm for its parasitic mode of life
 - 5.3.9.7 Describe the way in which a tapeworm has become degenerate
 - 5.3.9.8 Name the most highly developed system in the tapeworm
 - 5.3.9.9 Explain how tapeworm infestations in man may be prevented
- 5.4 Nematelminthes
 - 5.4.1 Compare the general form of the flatworm with the roundworms
 - 5.4.2 Explain how the roundworms show an advance over the flatworms
 - 5.4.3 Name four parasitic roundworms
 - 5.4.4 Name three harmless roundworms
 - 5.4.5 Name the type of symmetry exhibited by the roundworms
 - 5.4.6 Describe the general habitats of roundworms
 - 5.4.7 The Ascaris
 - 5.4.7.1 Trace the life cycle of an Ascaris worm from the egg to an adult that produces another egg which develops
 - 5.4.7.2 Describe the anatomy of Ascaris
 - 5.4.7.3 Differentiate between a male and female Ascaris
 - 5.4.7.4 Explain how the body systems of Ascaris worms are modified for a parasitic way of life
 - 5.4.7.5 Give the habitat of Ascaris
 - 5.4.8 The hookworm
 - 5.4.8.1 Describe how the hookworm enters the body
 - 5.4.8.2 Trace the path followed by a hookworm through the body (human) by naming all structures through which it passes
 - 5.4.8.3 Compare the size of the hookworm with that of the Ascaris
 - 5.4.8.4 Name the sections of the country where hookworms are commonly found
 - 5.4.8.5 Know three factors responsible for the spread of hookworm disease
 - 5.4.8.6 Name two illnesses caused by the hookworm
 - 5.4.8.7 List two means of preventing hookworm disease
 - 5.4.9 The trichina worm
 - 5.4.9.1 Describe the life cycle of the trichina worm
 - 5.4.9.2 Explain why the trichina worm is considered the most dangerous of the parasitic roundworms
 - 5.4.9.3 Define the term trichinosis
 - 5.4.9.4 Explain how trichinosis is caused in man
 - 5.4.9.5 Explain how trichinosis can be prevented
 - 5.4.10 Name a free-living roundworm
 - 5.4.11 Explain the structural differences between parasitic and free-living forms of worms
- 5.5 Annelida - (segmented worms)
 - 5.5.1 The common earthworm
 - 5.5.1.1 State the scientific name of the earthworm
 - 5.5.1.2 Describe the external structures of the earthworm
 - 5.5.1.3 Describe how the earthworm moves
 - 5.5.1.4 Name six well-developed systems of the earthworm
 - 5.5.1.5 Trace a particle of food through the digestive system of the earthworm, naming the organs through which it passes
 - 5.5.1.6 Compare the circulatory system of the earthworm with that of a simpler animal
 - 5.5.1.7 Identify the internal structures of the earthworm

- 5.5.1.8 Explain how excretion and respiration are accomplished in the earthworm
 - 5.5.1.9 Compare the advantages of the nervous system of the earthworms to those of the planarians
 - 5.5.1.10 Differentiate between nephridia and ganglia in the earthworm
 - 5.5.1.11 Explain the reproductive process carried on by earthworms
 - 5.5.1.12 Explain the economic importance of the earthworm
- 5.5.2 The leech
 - 5.5.2.1 Name the habitat of the leech
 - 5.5.2.2 Describe the structural characteristics of the leech
 - 5.5.2.3 Compare the food-getting method of the leech with that of the earthworm
 - 5.5.2.4 Describe the economic importance of the leeches
- 5.5.3 List the most important annelid features
- 5.6 Mollusca
 - 5.6.1 Explain the characteristics used in dividing the mollusks into classes
 - 5.6.2 Describe the structural similarities that indicate a relationship between the mollusks and annelids
 - 5.6.3 Know three characteristics all mollusks have in common
 - 5.6.4 List the three main classes of mollusks and explain how each body plan is modified
 - 5.6.5 Bivalves - the clam
 - 5.6.5.1 Explain the following terms as they relate to mollusks: valves, univalves, and bivalves
 - 5.6.5.2 Name four edible bivalve mollusks
 - 5.6.5.3 Know the three layers formed in the making of the shell of mollusks
 - 5.6.5.4 Explain how movement in the clam is accomplished
 - 5.6.5.5 Trace a particle of food from the outside of the clam to the digestive gland, naming the organs through which it passes
 - 5.6.5.6 Describe the nervous system of a bivalve
 - 5.6.5.7 Name the habitats of clams
 - 5.6.5.8 Describe the relationship between a type of one-celled alga and the giant clam
 - 5.6.6 Explain how pearls are formed in oysters
 - 5.6.7 The snail - a univalve
 - 5.6.7.1 Explain why snails are considered to be more representative of the phylum Mollusca than clams
 - 5.6.7.2 Compare and contrast the structure of the land snail with that of the clam
 - 5.6.7.3 Explain the land snail's adaptations which enable it to live out of water
 - 5.6.7.4 Compare the structure of a terrestrial snail with a slug
 - 5.6.7.5 Describe locomotion of the snail
 - 5.6.7.6 Name four mollusks with a one-piece shell
 - 5.6.7.7 Explain the function of the radula in the food-getting process of snails and slugs
 - 5.6.8 The cephalopods - "head-footed" mollusks
 - 5.6.8.1 Name four representatives of the class Cephalopoda
 - 5.6.8.2 State the differences among the octopus, the nautilus and the squid
 - 5.6.8.3 Compare the size of the octopus and squid
 - 5.6.8.4 Describe the habitat of the cephalopods
- 5.7 Echinodermata
 - 5.7.1 Give the meaning of the name of the phylum Echinodermata
 - 5.7.2 Describe the environment of echinoderms
 - 5.7.3 The starfish
 - 5.7.3.1 Describe movement of the starfish
 - 5.7.3.2 Explain how the water-vascular system assist the starfish in eating
 - 5.7.3.3 Name the type of symmetry exhibited by the adult starfish
 - 5.7.3.4 Describe two relatives of the starfish
 - 5.7.3.5 Compare the sea urchin with the starfish
 - 5.7.3.6 Describe external fertilization as it occurs in the case of the starfish
 - 5.7.3.7 Compare the larva of an echinoderm with the trochophore larval type of mollusks
- 5.8 Arthropoda
 - 5.8.1 Describe five structural similarities of all arthropods
 - 5.8.2 Compare the structural characteristics of the arthropods and annelids
 - 5.8.3 Explain why the arthropods are considered to be the most successful of all animal groups
 - 5.8.4 Explain how the chitinous exoskeleton and the metameric body design probably promoted the broad diversification of phylum Arthropoda
 - 5.8.5 Name the five principle classes of arthropods and give one example of each class
 - 5.8.6 Crustacea
 - 5.8.6.1 Describe the characteristics of the crayfish that illustrate the class Crustacea
 - 5.8.6.2 Name the places crayfishes are usually found in the United States

- 5.8.6.3 Identify the parts of the body regions of the crayfish
- 5.8.6.4 Know the function performed by each of the following structures in the activities of a crayfish: antennae, mandibles, compound eyes, green gland, swimmerets, and chelipeds
- 5.8.6.5 Name three sense organs located on the head of the crayfish
- 5.8.6.6 Differentiate between homologous and analogous organs giving one example of each using the crayfish
- 5.8.6.7 Describe how a crayfish eats and digests its food
- 5.8.6.8 Compare the circulatory system of a crayfish with that of an earthworm
- 5.8.6.9 Compare the nervous system of the crayfish with the annelids
- 5.8.6.10 Locate the gills of the crayfish
- 5.8.6.11 Explain how water is circulated over the gills of a crayfish
- 5.8.6.12 Describe how oxygen is carried in the blood of a crayfish
- 5.8.6.13 Describe reproduction and growth in the crayfish
- 5.8.6.14 Explain why molting is necessary in animals with exoskeletons
- 5.8.6.15 Name one way in which the crayfish is considered beneficial
- 5.8.6.16 Describe the economic importance of the following crustaceans: spiny lobster, blue crab, and shrimp
- 5.8.6.17 Name and describe several minute fresh-water crustaceans
- 5.8.6.18 Name the habitat of the barnacles
- 5.8.6.19 Explain how barnacles are considered harmful and beneficial to their environment
- 5.8.6.20 Describe the structural characteristics of isopods
- 5.8.7 Arachnida
 - 5.8.7.1 Know the characteristics the class name, Arachnida, describes
 - 5.8.7.2 Name five common organisms included in class Arachnida
 - 5.8.7.3 Compare the structures of the spider with those of an insect
 - 5.8.7.4 Explain the value of ballooning to the spider
 - 5.8.7.5 Identify two poisonous spiders
 - 5.8.7.6 Compare the structure of the scorpion and the spider
 - 5.8.7.7 Describe how spiders and scorpions breathe by means of book lungs
 - 5.8.7.8 Explain the economic importance of arachnids
- 5.8.8 Chilopoda and Diplopoda
 - 5.8.8.1 Describe the habitat of centipedes and millipeds
 - 5.8.8.2 Know the taxonomic definition of centipede and millipede
 - 5.8.8.3 Explain how a centipede differs from a millipede
- 5.8.9 Insecta - general characteristics
 - 5.8.9.1 Define the terms entomology and entomologist
 - 5.8.9.2 Know five ways in which all adult insects are alike
 - 5.8.9.3 Outline the basic characteristics which distinguish the insects from other arthropods
 - 5.8.9.4 Outline the basic characteristics which separate the insects from the arachnids
 - 5.8.9.5 Describe the adaptations of varied mouthparts of insects
 - 5.8.9.6 Describe how wings and legs are modified in different insect groups
 - 5.8.9.7 Explain metamorphosis as it occurs in different insects
 - 5.8.9.8 Describe the hormonal control of insect molting and development
 - 5.8.9.9 Name the three body regions of an insect
 - 5.8.9.10 Order Orthoptera
 - 5.8.9.10.1 Know the meaning of the order name Orthoptera
 - 5.8.9.10.2 Compare the skeletons of the crayfish and the grasshopper
 - 5.8.9.10.3 Name the characteristics of the grasshopper that place it in class Insecta
 - 5.8.9.10.4 Name and describe the mouthparts of a grasshopper
 - 5.8.9.10.5 Describe the grasshopper's locomotory appendages
 - 5.8.9.10.6 Differentiate between the forewings and hindwings of the grasshopper
 - 5.8.9.10.7 Name the eight body systems of the grasshopper
 - 5.8.9.10.8 Describe the functions of the eight body systems of the grasshopper
 - 5.8.9.10.9 Explain the chief differences between the blood system of the grasshopper and that of man
 - 5.8.9.10.10 Differentiate between closed and open circulatory systems
 - 5.8.9.10.11 Locate and describe five sense organs of the grasshopper
 - 5.8.9.10.12 Name five relatives of the grasshopper
 - 5.8.9.10.13 Name a relative of the grasshopper which is considered to be a useful animal and explain why it is so considered
 - 5.8.9.11 Order Lepidoptera
 - 5.8.9.11.1 Compare the mouthparts, use of the legs and wings, and the metamorphosis of the butterfly with the grasshopper
 - 5.8.9.11.2 Describe the life history of Lepidoptera
 - 5.8.9.11.3 Compare butterflies and moths
 - 5.8.9.12 Order Hymenoptera
 - 5.8.9.12.1 Name four members of the order Hymenoptera
 - 5.8.9.12.2 Describe the general characteristics of the order Hymenoptera

- 5.8.9.12.3 Explain the structural and functional differences among a queen, a drone, and a worker
- 5.8.9.12.4 Describe three differences in social organization of a bee colony and an ant colony
- 5.8.9.12.5 Describe swarming in the bee colony
- 5.8.9.12.6 Explain why instinctive behavior of the Hymenoptera is often confused with intelligence
- 5.8.9.12.7 Describe how the bees communicate with one another
- 5.8.9.13 Name eleven orders of insects and give an example of each order
- 5.8.9.14 Outline the main stages in the life history of the housefly
- 5.8.9.15 The economic importance of insects
 - 5.8.9.15.1 Know nine harmful activities of insects
 - 5.8.9.15.2 Name seven useful processes and/or products of insects
- 5.8.9.16 The control of insect pests
 - 5.8.9.16.1 Name and describe four methods that can be used to control insect pests
 - 5.8.9.16.2 Describe some disadvantages of chemical control
- 5.8.9.17 Know three factors that may account for the large number of insects

6.0 VERTEBRATE BIOLOGY - (CHORDATA)

- 6.1 Chordate characteristics
 - 6.1.1 Know three unique characteristics that distinguish chordates from other animals
 - 6.1.2 List three characteristics of each of the following: Hemichordata, Urochordata, Cephalochordata, and Vertebrata
 - 6.1.3 Draw a chordate tree
 - 6.1.4 Name the ten systems of the vertebrate body and state the general function of each system
 - 6.1.5 General characteristics of classes of vertebrates
 - 6.1.5.1 Know the seven classes of vertebrates in the order of their structural complexity
 - 6.1.5.2 Give an example of each class of vertebrates
 - 6.1.5.3 Explain how the complex anatomical changes in the classes of vertebrates show the change from water existence to life on the land
 - 6.1.6 Define and give an example of the following: behavior (general term), innate behavior, reflexes, instincts, self-preservation, species preservation, conditioned reaction, and intelligent behavior
- 6.2 Fishes
 - 6.2.1 Cyclostomata (Agnatha)
 - 6.2.1.1 Name five characteristics of the lamprey
 - 6.2.1.2 Know the economic importance of the sea lamprey in the fishing industry
 - 6.2.2 Chondrichthyes (Elasmobranchii)
 - 6.2.2.1 Describe five characteristics of sharks
 - 6.2.2.2 Compare the anatomy of a shark to that of the bony fish
 - 6.2.3 Osteichthyes (Pices)
 - 6.2.3.1 Know five characteristics of fish
 - 6.2.3.2 Draw and label the external structure of a perch
 - 6.2.3.3 Label a drawing showing the internal structures of a perch
 - 6.2.3.4 Describe the structures of the fish brain and tell the function of each part
 - 6.2.3.5 Trace the path of a drop of blood through the circulatory system; emphasize the passage through the heart and gills
 - 6.2.3.6 List the organs of the digestive tract in the order in which food passes through them
 - 6.2.4 Describe the anatomical structures that enable the fish to swim
 - 6.2.5 Define the following terms: chromatophores, guanine crystals, counter shading, and spawning
 - 6.2.6 Know six ways in which fish are of economic importance to man
- 6.3 Amphibia
 - 6.3.1 Know eight characteristics which distinguish amphibians from other vertebrate animals
 - 6.3.2 Orders of amphibians
 - 6.3.2.1 Order Apoda (Caecilians)
 - 6.3.2.1.1 Know three characteristics of caecilians
 - 6.3.2.1.2 Identify two specimen of the order Apoda
 - 6.3.2.2 Order Caudata - salamanders, newts, sirens
 - 6.3.2.2.1 Name four characteristics of salamanders
 - 6.3.2.2.2 Know four species of salamanders common to this part of the United States
 - 6.3.2.3 Order Salientia - frogs and toads
 - 6.3.2.3.1 Know five characteristics of frogs
 - 6.3.2.3.2 Distinguish between frogs and toads
 - 6.3.3 Explain how the lung fish and the coelacanth seem to be the transitional forms between fish and amphibians

- 6.3.4 Draw a labeled diagram of the life history of the frog from egg to adult
- 6.3.5 Write a summary of the changes that occur as the tadpole develops into the frog; emphasize the changes from a tadpole that must live in water to the frog that can live on land
- 6.3.6 The frog - (a representative amphibian)
 - 6.3.6.1 External structures of the frog
 - 6.3.6.1.1 Label a drawing of the external structures of the frog
 - 6.3.6.1.2 Describe the skin, head, and legs of the frog
 - 6.3.6.2 Internal anatomy of the frog
 - 6.3.6.2.1 Name the structures in the mouth and describe the close relationship between structure and function in croaking, capturing food, and in passing food to the stomach and air to the lungs
 - 6.3.6.2.2 Make an outline showing the organs that make up the following systems: digestive system, respiratory system, circulatory system, nervous system, excretory system, and reproductive system
 - 6.3.6.2.3 Label diagrams of the various systems of the frog
 - 6.3.6.3 Know three ways in which frogs are of economic importance to man
- 6.4 Reptilia
 - 6.4.1 Ancient reptiles
 - 6.4.1.1 Know the geological periods that can be identified with the rise, supremacy, and decline of reptiles
 - 6.4.1.2 Name one flesh-eating dinosaur, one plant-eating dinosaur, and one flying reptile; describe each as fossil evidence indicates they may have been
 - 6.4.2 The rise of reptiles
 - 6.4.2.1 Explain how the development of the amniote egg made the rise of the reptile possible
 - 6.4.2.2 Describe the following parts of the amniote egg: shell, chorion, amnion, allantois, and yolk
 - 6.4.3 List six body characteristics which enable a reptile to live entirely on land
 - 6.4.4 Orders of living reptiles
 - 6.4.4.1 Name four orders of living reptiles and give an example of each
 - 6.4.4.2 Explain why the sphenodon is of special interest to biologists
 - 6.4.4.3 Describe the gila monster as to its appearance, its structures for biting, and its venom type
 - 6.4.4.4 Describe the crocodilian adaptations for breathing
 - 6.4.4.5 Know three adaptations that have enabled the turtle to survive through the ages of time
 - 6.4.4.6 Snakes - the most widespread reptile
 - 6.4.4.6.1 Describe the structures of the head that are related to the senses of smell, sight, and response to vibration
 - 6.4.4.6.2 Describe the structures of the mouth and jaw which enable the snake to capture and swallow prey
 - 6.4.4.6.3 Name three groups of snakes based on feeding habits and give an example of each
 - 6.4.4.6.4 Describe three kinds of locomotion exhibited by snakes
 - 6.4.4.6.5 Know the four groups of poisonous snakes common to the United States and give an example of each
 - 6.4.4.6.5.1 Describe the poisonous snakes by body structures, patterns of color, and design
 - 6.4.4.6.6 Distinguish between the two types of toxin present in snake venom and describe the effect that each has on a snake bite victim
 - 6.4.5 Name four ways in which turtles and snakes are of economic importance to man
- 6.5 Aves - (the birds)
 - 6.5.1 Ancient birds
 - 6.5.1.1 Know the biological significance of the fossil bird, Archaeopteryx
 - 6.5.1.2 Describe Archaeopteryx as the biologists think it may have looked
 - 6.5.2 Modern birds
 - 6.5.2.1 Name two characteristics of birds that resemble reptiles
 - 6.5.2.2 Know eight characteristics that distinguish birds from other vertebrates
 - 6.5.3 Adaptations for flight
 - 6.5.3.1 Describe the structures of birds which enable them to fly
 - 6.5.3.2 Feathers
 - 6.5.3.2.1 Give the name and function of three kinds of plumage feathers
 - 6.5.3.2.2 Distinguish between the four kinds of flight feathers
 - 6.5.3.2.3 Label a diagram of a quill feather
 - 6.5.3.2.4 Describe in detail the bone structure of the wing and shoulder and the attachment of the muscles that enable the bird to fly
 - 6.5.4 The systems of the body
 - 6.5.4.1 Name the organs of the digestive tract in the order that food passes through the bird's body

- 6.5.4.2 Circulatory system
 - 6.5.4.2.1 Trace a drop of blood through the circulatory system of a bird
 - 6.5.4.2.2 Tell how the circulatory system of the bird differs from that of the amphibian and reptile
- 6.5.4.3 Respiratory system
 - 6.5.4.3.1 Name the organs of the respiratory system and tell how breathing is controlled by the action of the thoracic and abdominal muscles
 - 6.5.4.3.2 Explain how the respiratory system helps to regulate body temperature
 - 6.5.4.3.3 Describe the syrinx and tell its function
- 6.5.4.4 The excretory system
 - 6.5.4.4.1 Name the waste product excreted by the kidneys
 - 6.5.4.4.2 Explain why the excretion of uric acid rather than urine is considered to be an adaptation for flight
- 6.5.4.5 The nervous system
 - 6.5.4.5.1 Name the structures of the brain
 - 6.5.4.5.2 Contrast the relative size of the cerebrum with that of the fish and frog
 - 6.5.4.5.3 Rate the senses of sight, hearing, smell, and taste as well or poorly developed
- 6.5.4.6 The reproductive system
 - 6.5.4.6.1 Describe the formation of the egg as it passes from the ovary to the cloaca
 - 6.5.4.6.2 Label a diagram of a chicken egg
- 6.5.5 Feeding and nesting habits of birds
 - 6.5.5.1 Explain the close relationship between the structure and function as illustrated by the beak, feet, and wings in the feeding habits of birds
 - 6.5.5.2 Describe the nesting habits and care of the young as shown by precocial birds
 - 6.5.5.3 Describe the nesting habits and care of the young as shown by the altricial birds
- 6.5.6 Economic importance of birds
 - 6.5.6.1 Explain how birds help in controlling insects and rodents
 - 6.5.6.2 Relate birds to food for man and other animals
 - 6.5.6.3 Describe the value of using eggs as laboratory cultures
 - 6.5.6.4 Explain the value of birds used in recreation and as hobbies
 - 6.5.6.5 Relate birds to the aesthetic values of man
- 6.6 Class Mammalia
 - 6.6.1 The rise of mammals
 - 6.6.1.1 Describe the Mesozoic mammals of the Jurassic and Cretaceous periods
 - 6.6.1.2 Describe the development of the horse as it has been reconstructed from fossils
 - 6.6.2 Name ten characteristics of class Mammalia
 - 6.6.3 Lines of mammalian development
 - 6.6.3.1 Monotremes - (the egg-laying mammals)
 - 6.6.3.1.1 Describe the duck-billed platypus as to appearance, its way of reproduction and care of the young
 - 6.6.3.1.2 List three similarities between the platypus and reptiles
 - 6.6.3.2 The marsupials - (pouched mammals)
 - 6.6.3.2.1 Describe the unique method of reproduction and care of the young shown by marsupials
 - 6.6.3.2.2 Discuss the North American opossum and the Australian kangaroo as good examples of marsupials
 - 6.6.3.2.3 Explain how the marsupials are good examples of convergent evolution
 - 6.6.3.3 The placental mammals - the young developed inside the body of the mother
 - 6.6.3.3.1 Name eleven orders of placental mammals, state the general identifying characteristic of each order, and give an example of each order
 - 6.6.3.3.2 Describe each order by using a representative example and describing its way of life
 - 6.6.3.3.3 Name five characteristics of primates that place them at the top of all groups of living things
 - 6.6.4 The supremacy of mammals over other vertebrates
 - 6.6.4.1 Name several structural advantages that enable mammals to live in diverse environments
 - 6.6.4.2 Explain how the regulated internal environment is a definite biological advantage to mammals
 - 6.6.4.3 Explain how the successful distribution of mammalian life is related to the efficient method of reproduction, the number of young, and the length of parental care

- 6.6.5 The systems of the body
 - 6.6.5.1 The circulatory system
 - 6.6.5.1.1 Describe the structure of the mammalian heart
 - 6.6.5.1.2 Compare the structure of the mammalian heart to the heart of the fish, frog, turtle, and bird
 - 6.6.5.2 Name the organs of the respiratory system
 - 6.6.5.3 Name the organs of the alimentary canal
 - 6.6.5.4 The nervous system
 - 6.6.5.4.1 Name the main parts of the brain and tell the function of each part
 - 6.6.5.4.2 Know the importance of the cerebrum
 - 6.6.5.4.3 Explain how the success of mammalian life is closely related to the highly developed nervous system
- 6.6.6 Tell how the following orders of mammals are of great importance to man: Rodentia, Lagomorpha, Cetacea, Carnivora, and Ungulata

7.0 HUMAN BIOLOGY

- 7.1 The history of man
 - 7.1.1 Man and mammals
 - 7.1.1.1 List similarities of man and other mammals
 - 7.1.1.2 List differences between man and other mammals
 - 7.1.2 Darwin's theory
 - 7.1.2.1 Explain Darwin's ideas concerning the development of man
 - 7.1.2.2 Explain the misunderstanding that often exists in regard to Darwin's theory
 - 7.1.3 Early primates
 - 7.1.3.1 Identify Australopithecus africanus
 - 7.1.3.2 List the ways in which Dr. Leakey's find, Zinjanthropus, differs from modern apes
 - 7.1.3.3 Describe the probable appearance of Pithecanthropus erectus and list some facts about his life
 - 7.1.3.4 Identify Neanderthal man as to physical description, habitat, and the approximate time he flourished
 - 7.1.3.5 Know where and when Cro-Magnon man lived and describe him
 - 7.1.4 Modern man
 - 7.1.4.1 Name the species to which all modern men belong
 - 7.1.4.2 List the ways in which modern man is superior to ancient man
- 7.2 General organization of the body
 - 7.2.1 Tissues
 - 7.2.1.1 Define the term tissue
 - 7.2.1.2 Name the five kinds of tissues; tell where each is found
 - 7.2.1.3 Give the function of each tissue found in man
 - 7.2.2 Organs
 - 7.2.2.1 Define the term organ
 - 7.2.2.2 Name the organ systems
 - 7.2.3 Body regions
 - 7.2.3.1 Describe the general body plan
 - 7.2.3.2 Name the three major cavities and the organs in each cavity
 - 7.2.3.3 Name the structures enclosing each cavity
 - 7.2.4 The body framework
 - 7.2.4.1 List the advantages and disadvantages of an endoskeleton
 - 7.2.4.2 List five functions of the skeleton
 - 7.2.4.3 Bones
 - 7.2.4.3.1 Describe the change from cartilage to bone as the body develops
 - 7.2.4.3.2 Name the bones which develop from membranes
 - 7.2.4.3.3 Define the term ossification
 - 7.2.4.3.4 Name five areas where permanent cartilage is found
 - 7.2.4.3.5 Give the function of stress in bone growth
 - 7.2.4.3.6 Diagram the structure of a long bone and give the function of each part
 - 7.2.4.3.7 Describe the red marrow as to location and function
 - 7.2.4.3.8 Describe the yellow marrow as to location and function
 - 7.2.4.3.9 Other than size, name a difference between the small bones and the large bones
 - 7.2.4.3.10 Give the approximate number of bones in the human body
 - 7.2.4.3.11 Using general terms, name the bones which make up the appendicular skeleton
 - 7.2.4.3.12 Using general terms, name the bones comprising the axial skeleton
 - 7.2.4.3.13 Name and locate fifty bones of man
 - 7.2.4.4 Joints
 - 7.2.4.4.1 Define the term joint
 - 7.2.4.4.2 Name and locate four types of joints
 - 7.2.4.4.3 Give the name of the tough connective tissue which holds ball and socket and hinge joints in place

- 7.2.4.4.4 Name the material which covers the inner surfaces of joints
- 7.2.4.4.5 Explain how joints are lubricated
- 7.2.4.5 Muscles
 - 7.2.4.5.1 State the approximate number of different muscles in the human body
 - 7.2.4.5.2 Give the chief function of muscles
 - 7.2.4.5.3 Types of muscles
 - 7.2.4.5.3.1 Name three types of muscles
 - 7.2.4.4.3.2 Give where each type of muscle is located
 - 7.2.4.4.3.3 Give the function of each type of muscle
 - 7.2.4.4.3.4 Make three drawings illustrating the differences in the appearance of the three types of muscle tissue
 - 7.2.4.5.4 Function of muscles
 - 7.2.4.5.4.1 Using a diagram, explain the current concept of muscle contraction
 - 7.2.4.5.4.2 Name the parts of a motor unit
 - 7.2.4.5.4.3 Explain how muscles work in pairs by drawing the biceps-triceps arrangement
 - 7.2.4.5.4.4 Give the advantage of having the cells in the adjacent layers of smooth muscles at right angles to each other
 - 7.2.4.5.4.5 Define the term muscle tone
 - 7.2.4.5.4.6 Explain how the action of heart muscle is unlike that of any other muscle
 - 7.2.4.5.4.7 Name, locate, and give the function of thirty muscles of the human body
- 7.3 Nutrition
 - 7.3.1 Foods
 - 7.3.1.1 Water
 - 7.3.1.1.1 Draw a diagram to show the relationship of the water content of the body to the total body weight
 - 7.3.1.1.2 List five important functions of water in the body
 - 7.3.1.1.3 Name three ways by which the water requirements of the body are met
 - 7.3.1.2 Mineral salts
 - 7.3.1.2.1 Give the normal percentage of mineral salts in the blood
 - 7.3.1.2.2 Construct a chart listing the names, functions, and sources of the mineral salts needed in the body
 - 7.3.1.3 Vitamins
 - 7.3.1.3.1 Define the term vitamin
 - 7.3.1.3.2 Construct a chart listing the names, functions, and sources of the vitamins needed by the body
 - 7.3.1.3.3 Make a statement concerning the use of synthetic vitamins
 - 7.3.1.4 Carbohydrates
 - 7.3.1.4.1 List five sources of edible carbohydrates
 - 7.3.1.4.2 Name the form in which carbohydrates are stored in the liver
 - 7.3.1.4.3 Name the form in which all digestible carbohydrates reach the tissues
 - 7.3.1.4.4 Name the complex carbohydrates which cannot be digested by man but serve as roughage in the digestive system
 - 7.3.1.5 Fats
 - 7.3.1.5.1 Compare a carbohydrate and a fat as to the hydrogen-oxygen ratio in the molecules
 - 7.3.1.5.2 Account for the high energy-yield of fats
 - 7.3.1.5.3 Define the term calorie
 - 7.3.1.5.4 List five sources of edible fats
 - 7.3.1.5.5 Name the source of body fat and the three main body areas where it is stored
 - 7.3.1.5.6 Give three reasons why excess body fat is harmful to the health
 - 7.3.1.6 Proteins
 - 7.3.1.6.1 Name the unit structures of a protein
 - 7.3.1.6.2 Describe a protein molecule as to size and complexity
 - 7.3.1.6.3 Name two vital processes which depend on protein intake
 - 7.3.1.6.4 Know what deamination is and where it takes place
 - 7.3.1.6.5 List five sources of edible protein
 - 7.3.2 Digestion
 - 7.3.2.1 The alimentary canal - structures and actions
 - 7.3.2.1.1 The mouth
 - 7.3.2.1.1.1 Locate and describe the following: hard palate, soft palate, uvula, pharynx, and cheek linings
 - 7.3.2.1.1.2 Name, locate, and give the function of the salivary glands

- 7.3.2.1.1.3 Name a disease of a salivary gland
- 7.3.2.1.1.4 Describe the tongue and list its functions
- 7.3.2.1.1.5 List the types of teeth giving the number and function of each
- 7.3.2.1.1.6 Draw a "permanent" tooth, label its parts, and list the function of each part
- 7.3.2.1.2 The esophagus and the stomach
 - 7.3.2.1.2.1 Describe the esophagus and state its function
 - 7.3.2.1.2.2 List the muscle layers of the stomach
 - 7.3.2.1.2.3 Name three gastric secretions
 - 7.3.2.1.2.4 Describe the churning action of the stomach
 - 7.3.2.1.2.5 Name and locate the valves of the stomach
- 7.3.2.1.3 The small intestine
 - 7.3.2.1.3.1 Name the regions of the small intestine, giving the location and approximate size of each region
 - 7.3.2.1.3.2 Define the terms villi, peristalsis, and intestinal fluid
- 7.3.2.1.4 The liver
 - 7.3.2.1.4.1 Locate and describe the liver
 - 7.3.2.1.4.2 Name the secretion of the liver and tell where it is stored
 - 7.3.2.1.4.3 Name the disease which occurs as a result of the common bile duct being obstructed
- 7.3.2.1.5 The pancreas
 - 7.3.2.1.5.1 Locate and describe the pancreas
 - 7.3.2.1.5.2 Name the two entirely different secretions of the pancreas
- 7.3.2.1.6 The colon
 - 7.3.2.1.6.1 Locate and describe the colon
 - 7.3.2.1.6.2 Name and locate the regions of the colon
- 7.3.2.2 The alimentary canal - digestion and absorption
 - 7.3.2.2.1 The chemical phases of digestion
 - 7.3.2.2.1.1 Construct a chart showing the places digestion occurs
 - 7.3.2.2.1.2 Name the glands involved in digestion
 - 7.3.2.2.1.3 Know the secretions and the enzymes involved in digestive activities
 - 7.3.2.2.2 Absorption
 - 7.3.2.2.2.1 Explain absorption in the small intestine by drawing a villus and listing the substance absorbed by each part
 - 7.3.2.2.2.2 Name the substance absorbed by the large intestine (colon) and the waste eliminated through the anus

7.4 Circulation

- 7.4.1 Parts of the circulatory system
 - 7.4.1.1 Classify blood as to tissue type
 - 7.4.1.2 State the approximate amount of blood in an average person
 - 7.4.1.3 The plasma
 - 7.4.1.3.1 Name the compound which makes up nine-tenths of the plasma
 - 7.4.1.3.2 Name three proteins in the plasma and give a function of each
 - 7.4.1.3.3 Name the enzyme in the plasma which is active during blood clot formation
 - 7.4.1.3.4 List the inorganic minerals which must be present in the plasma in order for body tissues to function normally
 - 7.4.1.3.5 List the forms of digested food in the plasma
 - 7.4.1.3.6 Name the waste materials which travel in the plasma to organs of excretion
 - 7.4.1.4 Solid components of blood
 - 7.4.1.4.1 Describe the red blood cells, tell where they are formed and how they function
 - 7.4.1.4.2 Give the life span of a red blood cell
 - 7.4.1.4.3 Define the terms hemolysis, anemia, hemoglobin, tissue suffocation, erythrocyte, leucocyte, phagocyte, and leukemia
 - 7.4.1.4.4 Describe the white blood cells, tell where they are formed and how they function
 - 7.4.1.4.5 Describe the platelets and give their function
 - 7.4.1.4.6 State the ratio of white cells to red cells in a cubic centimeter of normal blood
 - 7.4.1.5 Blood clot formation
 - 7.4.1.5.1 List the steps in blood clot formation
 - 7.4.1.5.2 Define the terms bruise, embolus, and hematoma
 - 7.4.1.6 Blood transfusions
 - 7.4.1.6.1 Describe the four types of blood

- 7.4.1.6.2 List the steps in the blood-typing process
 - 7.4.1.6.3 Give the importance of the Rh factor in transfusions and in childbirth
 - 7.4.1.6.4 Define the terms antibody, antigen, and plasma transfusion
 - 7.4.2 Circulations in the body
 - 7.4.2.1 Describe the pulmonary, systemic, coronary, renal, and portal phases of circulation
 - 7.4.2.2 Describe the circulation of the lymph
- 7.5 Excretion
 - 7.5.1 The kidneys
 - 7.5.1.1 Diagram a kidney and its associated adrenal glands, blood vessels, ureters, urinary bladder, and urethra
 - 7.5.1.2 Draw a nephron
 - 7.5.1.3 Describe the process of waste removal by the kidneys
 - 7.5.2 The skin
 - 7.5.2.1 Make a drawing of the skin and identify each part
 - 7.5.2.2 Describe the process of waste removal by the skin
 - 7.5.2.3 List the functions of the skin other than excretion
 - 7.5.3 Other organs of waste removal
 - 7.5.3.1 Name the wastes excreted by the lungs
 - 7.5.3.2 Name the products excreted by the liver
 - 7.5.3.3 Name the waste removed by the large intestine
- 7.6 Respiration and energy exchange
 - 7.6.1 External respiration
 - 7.6.1.1 The nose and nasal passages
 - 7.6.1.1.1 List three functions of the nasal passages
 - 7.6.1.1.2 Describe the linings of the air passageways
 - 7.6.1.2 The pharynx and trachea
 - 7.6.1.2.1 Define the terms epiglottis, larynx, vocal cords, cilia and cartilage
 - 7.6.1.2.2 Describe the effect of air pollution on the trachea and lungs
 - 7.6.1.3 The bronchi and lungs
 - 7.6.1.3.1 Give the relationship among trachea, bronchi, bronchial tubes, bronchioles, and air sacs
 - 7.6.1.3.2 Name the double covering of the lungs
 - 7.6.1.3.3 Name the component parts of the lungs
 - 7.6.1.3.4 Diagram and explain gas exchange between alveoli and capillaries
 - 7.6.1.3.5 Explain how hemoglobin releases oxygen in the tissues
 - 7.6.1.3.6 Explain why carbon dioxide and water diffuse out of the blood and into the alveoli
 - 7.6.1.3.7 Define the terms tidal air, supplemental air, residual air, and complemental air
 - 7.6.1.4 The mechanics of breathing
 - 7.6.1.4.1 Explain the actions of the rib muscles and the diaphragm during inspiration
 - 7.6.1.4.2 Explain the actions of the rib muscles and the diaphragm during expiration
 - 7.6.1.4.3 Name two factors which control breathing rate
 - 7.6.1.4.4 List the steps in giving mouth-to-mouth artificial breathing
 - 7.6.2 Internal respiration
 - 7.6.2.1 Name the waste products of aerobic respiration given off when sufficient oxygen is supplied to muscle tissue
 - 7.6.2.2 Name the hydrogen acceptor when the muscle tissue has insufficient oxygen
 - 7.6.2.3 Name the waste products formed in muscle tissues due to insufficient oxygen
 - 7.6.2.4 Identify the compound which produces muscle fatigue when it accumulates in the tissues
 - 7.6.2.5 Define the terms oxygen debt, basal metabolism, calorimeter, and tissue suffocation
- 7.7 Body control - the nervous system
 - 7.7.1 Neurons
 - 7.7.1.1 Name three types of nerve cells
 - 7.7.1.2 Locate three types of nerve cells
 - 7.7.1.3 Give the function of three types of nerve cells
 - 7.7.1.4 Diagram a typical motor neuron
 - 7.7.2 Synapses
 - 7.7.2.1 Define the term synapse
 - 7.7.2.2 Explain how an impulse is transmitted across a synapse
 - 7.7.3 Nerve impulses
 - 7.7.3.1 Compare the speed of a nerve impulse with that of an electrical impulse
 - 7.7.3.2 Explain the role of acetylcholine in nerve-muscle action
 - 7.7.3.3 Name the chemical released by the nerve to counteract the effect of acetylcholine

- 7.7.4 The central nervous system
 - 7.7.4.1 The brain
 - 7.7.4.1.1 Name the three membranes which cover the brain and spinal cord
 - 7.7.4.1.2 Ventricles
 - 7.7.4.1.2.1 Name the four ventricles within the brain
 - 7.7.4.1.2.2 Describe the lining of the cavities
 - 7.7.4.1.2.3 Name the fluid in the cavities and tell how it is kept in motion
 - 7.7.4.1.3 The cerebrum
 - 7.7.4.1.3.1 Describe the cerebrum
 - 7.7.4.1.3.2 Name the lobes of the cerebrum
 - 7.7.4.1.3.3 List the functions of each lobe of the cerebrum
 - 7.7.4.1.4 The cerebellum
 - 7.7.4.1.4.1 Locate and describe the cerebellum
 - 7.7.4.1.4.2 List the functions of the cerebellum
 - 7.7.4.1.5 The brain stem
 - 7.7.4.1.5.1 Name and locate the parts of the brain stem
 - 7.7.4.1.5.2 List the functions of each part of the brain stem
 - 7.7.4.1.6 The cranial nerves
 - 7.7.4.1.6.1 Name the system to which the cranial nerves belong
 - 7.7.4.1.6.2 Name the twelve pairs of cranial nerves and list the function of each
 - 7.7.4.2 The spinal cord and spinal nerves
 - 7.7.4.2.1 Draw and label a diagram of the spinal cord
 - 7.7.4.2.2 Describe the spinal nerves as to number, types, and the system to which they belong
- 7.7.5 The autonomic nervous system
 - 7.7.5.1 The sympathetic system
 - 7.7.5.1.1 Locate the sympathetic system
 - 7.7.5.1.2 Describe the sympathetic system
 - 7.7.5.1.3 Give the functions of the sympathetic system
 - 7.7.5.1.4 Define the terms ganglia and solar plexus
 - 7.7.5.2 The parasympathetic system
 - 7.7.5.2.1 Explain the sympathetic-parasympathetic relationship
 - 7.7.5.2.2 Name and locate the principle nerve of the parasympathetic system
- 7.7.6 Sensation
 - 7.7.6.1 The skin
 - 7.7.6.1.1 Name the five types of receptors in the skin
 - 7.7.6.1.2 Name the receptor which will respond to any stimulus if the stimulus is strong enough
 - 7.7.6.2 The tongue
 - 7.7.6.2.1 Draw and label a taste receptor of the tongue
 - 7.7.6.2.2 List the four taste sensations
 - 7.7.6.3 The nose
 - 7.7.6.3.1 Describe the structure of the nasal passages
 - 7.7.6.3.2 Name the nerve associated with the sense of smell
 - 7.7.6.3.3 Explain how the receptors may become insensitive
 - 7.7.6.4 The ear
 - 7.7.6.4.1 Name each part of the ear
 - 7.7.6.4.2 Locate the parts of the ear
 - 7.7.6.4.3 Give the function of each part of the ear
 - 7.7.6.4.4 Name the nerve associated with the sense of hearing
 - 7.7.6.4.5 Explain how motion may produce motion sickness
 - 7.7.6.5 The eye
 - 7.7.6.5.1 Make a drawing showing the structure of the eye labeling each part
 - 7.7.6.5.2 Give the function of each part of the eye
 - 7.7.6.5.3 Explain color perception
 - 7.7.6.5.4 Identify visual purple and give its function
 - 7.7.6.5.5 List some abnormalities of the eye which would alter vision
 - 7.7.6.5.6 Explain what is meant by "20-20" vision
 - 7.7.6.5.7 Explain how the eyes are protected by location and structure
- 7.8 Three social and health problems - alcohol, narcotics, and tobacco
 - 7.8.1 Alcohol
 - 7.8.1.1 Give the chemical name of beverage alcohol
 - 7.8.1.2 List two general sources of sugars that are used to make alcohol
 - 7.8.1.3 Explain why alcohol is not considered to be a food
 - 7.8.1.4 List the harmful effects of drinking alcohol on the skin, the kidneys, the liver, and the stomach

- 7.8.1.5 Describe the effects of alcohol on the nervous system
- 7.8.1.6 Define the terms alcoholism, alcohol psychosis, delirium tremens, depressant, and Alcoholic Anonymous
- 7.8.1.7 Explain why insurance companies ask about the drinking habits of applicants
- 7.8.1.8 List six effects alcohol has on the driver of a car
- 7.8.1.9 Name the legal limit which most states have set for alcohol content of the blood before a person is said to be intoxicated
- 7.8.2 Narcotic drugs
 - 7.8.2.1 Define the terms narcotic, addiction, withdrawal symptoms, sedatives, and stimulating drugs
 - 7.8.2.2 State the relationships between opium, morphine, and codeine
 - 7.8.2.3 Name the synthetic narcotic produced from morphine
 - 7.8.2.4 Identify the plant from which opium is obtained
 - 7.8.2.5 Name the narcotic which is extracted from the leaves of the coca plant
 - 7.8.2.6 Name a drug which causes emotional addiction but does not cause physical addiction
 - 7.8.2.7 Describe the effects amphetamines have on the user
 - 7.8.2.8 State the damages which may occur from the long-range use of bromides
 - 7.8.2.9 Aside from dependence, name two severe hazards to barbiturate use
 - 7.8.2.10 Name three psychedelic drugs and tell why they are dangerous to use
 - 7.8.2.11 Discuss the relationship of drug use to crime
- 7.8.3 Tobacco
 - 7.8.3.1 List five ways smoking injures the health
 - 7.8.3.2 List reasons (other than health) why smoking is an undesirable habit
- 7.9 Body regulators - the ductless glands
 - 7.9.1 The thyroid gland
 - 7.9.1.1 Locate and describe the thyroid gland
 - 7.9.1.2 Name the secretion of the thyroid gland
 - 7.9.1.3 Identify the element concentrated in the thyroid secretion
 - 7.9.1.4 Describe the symptoms exhibited by an individual with an overactive thyroid gland
 - 7.9.1.5 Describe a condition caused by underactivity of the thyroid gland
 - 7.9.1.6 Define the terms cretinism, myxedema, and simple goiter
 - 7.9.2 The parathyroid glands
 - 7.9.2.1 Locate the parathyroid glands when supplied with an appropriate chart
 - 7.9.2.2 Describe the parathyroid glands
 - 7.9.2.3 Give the function of the parathyroid glands
 - 7.9.2.4 List the symptoms of parathyroid secretion deficiency
 - 7.9.3 The pituitary gland
 - 7.9.3.1 Locate the pituitary gland
 - 7.9.3.2 Describe the pituitary gland
 - 7.9.3.3 Name the two parts of the pituitary gland
 - 7.9.3.4 List the secretions of the anterior lobe of the pituitary gland
 - 7.9.3.5 Give the function of each secretion of the anterior lobe of the pituitary gland
 - 7.9.3.6 List the two secretions of the posterior pituitary gland
 - 7.9.3.7 Give the function of each secretion of the posterior lobe of the pituitary gland
 - 7.9.3.8 Define the terms diabetes insipidus, giant, acromegaly, and midget
 - 7.9.4 The adrenal glands
 - 7.9.4.1 Locate the adrenal glands when supplied with an appropriate chart
 - 7.9.4.2 Describe the adrenal glands
 - 7.9.4.3 Regions of adrenal glands
 - 7.9.4.3.1 Name the regions of the adrenal glands
 - 7.9.4.3.2 List the secretions of the adrenal cortex
 - 7.9.4.3.3 Give the function of each secretion from the adrenal cortex
 - 7.9.4.3.4 Identify Addison's disease
 - 7.9.4.3.5 Name the secretion of the adrenal medulla
 - 7.9.4.3.6 Describe the effect on the body in times of stress of the secretion from the adrenal medulla
 - 7.9.5 The pancreas
 - 7.9.5.1 Name the secretion of the Islets of Langerhans
 - 7.9.5.2 Give the functions of the pancreatic hormone
 - 7.9.5.3 Name the disease which causes an abnormal elevation of blood sugar
 - 7.9.5.4 State several facts concerning detection of diabetes and treatment of the disease
 - 7.9.5.5 Define hypoglycemia and tell how it is controlled
 - 7.9.6 The ovaries and testes
 - 7.9.6.1 Name the hormones secreted by the ovaries
 - 7.9.6.2 List the functions of secretions from the ovaries
 - 7.9.6.3 Name the hormone secreted by the testes
 - 7.9.6.4 List the functions of secretions from the testes
 - 7.9.6.5 Identify the sex hormone secreted by the adrenal cortex which may influence the degree of maleness and femaleness and which is responsible for the normal sex drive in the male

- 7.9.6.6 Explain the changes which a boy undergoes at the onset of puberty
- 7.9.6.7 Explain the changes which a girl undergoes at the onset of puberty
- 7.9.6.8 Define castration
- 7.9.6.9 Give two reasons for the practice of castration
- 7.9.7 The pineal body and the thymus
 - 7.9.7.1 Locate the pineal body
 - 7.9.7.2 Describe the pineal body
 - 7.9.7.3 Locate the thymus
 - 7.9.7.4 Describe the development of the thymus
 - 7.9.7.5 State the importance of the thymus
- 7.10 Reproduction and development
 - 7.10.1 Sexual reproduction
 - 7.10.1.1 Define the terms sexual reproduction, gamete, zygote, gonad, meiotic division, haploid cells, diploid cells
 - 7.10.1.2 Give the advantages of sexual reproduction over asexual reproduction
 - 7.10.2 Reproductive systems
 - 7.10.2.1 The male system
 - 7.10.2.1.1 Describe the male reproductive system, listing its parts and giving the function of each part
 - 7.10.2.1.2 Using a drawing, describe the sperm cell as to structure, size, motility, and number of sperms produced
 - 7.10.2.2 The female system
 - 7.10.2.2.1 Diagram the female system, label its parts, and give the function of each part
 - 7.10.2.2.2 Describe the ovarian cycle
 - 7.10.2.2.3 Describe the uterine cycle
 - 7.10.2.2.4 Define the terms follicle, FSH, estrogen, corpus luteum, LH, progesterone, and menstruation
 - 7.10.2.2.5 Outline the process of fertilization
 - 7.10.3 Development of the zygote
 - 7.10.3.1 Define the term embryo and give the length of time the human is in this stage
 - 7.10.3.2 Name the stage which follows the embryo stage
 - 7.10.3.3 Outline the process of development from the single cell stage to the formation of the umbilical cord
 - 7.10.3.4 List the structures formed from each of the three primitive germ layers
 - 7.10.3.5 Describe how the fetus obtains nourishment and oxygen
 - 7.10.3.6 Define the terms extraembryonic membranes, chorion, amnion, yolk sac, allantois, placenta, umbilical cord, navel, afterbirth, and ductus arteriosus
 - 7.10.3.7 Describe the birth process

8.0 ECOLOGICAL RELATIONSHIPS

- 8.1 Introduction to ecology
 - 8.1.1 Define the following: ecology, environment, abiotic environment, biotic environment, ecosystem, individual, population, organism, producer, consumer, order of consumer (first order, second order, etc.) biosphere, food chain, food web, and community
 - 8.1.2 The biosphere - the world of life
 - 8.1.2.1 The web of life
 - 8.1.2.1.1 Distinguish between producer organisms and consumer organisms
 - 8.1.2.1.2 Diagram a food chain
 - 8.1.2.1.3 Diagram a food web; use several different producers and consumers
 - 8.1.2.1.4 List factors that determine the kind of food that organisms try to secure
 - 8.1.3 Homeostasis - the steady state between the abiotic world and the biotic world
 - 8.1.3.1 Two fundamental laws
 - 8.1.3.1.1 The Law of Change
 - 8.1.3.1.1.1 Discuss the evolutionary changes, the short term changes, and the catastrophic changes that occur in the physical world
 - 8.1.3.1.1.2 Know how such changes affect the biosphere
 - 8.1.3.1.1.3 Discuss the evolutionary changes, short term changes, and physiological changes that occur in the living world and tell the effects of such changes
 - 8.1.3.1.2 The Law of Duration
 - 8.1.3.1.2.1 Explain how the abiotic world and the biotic world have endured through time in the face of constant change

- 8.1.4 Ecosystems
 - 8.1.4.1 Interactions that occur in an ecosystem
 - 8.1.4.1.1 Interactions between the biotic community and the abiotic environment
 - 8.1.4.1.1.1 Diagram the flow of energy and matter from the abiotic world into the biotic world by way of photosynthesis, the flow through the biotic world, and back to the abiotic world by way of death and decay
 - 8.1.4.1.2 Interactions that occur within the biotic community
 - 8.1.4.1.2.1 Distinguish between interspecific competition and intraspecific competition in the biotic community
 - 8.1.4.1.2.2 Indicate which form of competition is more severe and why
 - 8.1.4.1.3 Interactions within the physical environment
 - 8.1.4.1.3.1 Discuss the effects of the following factors on the physical environment: weather factors, solar radiation, wind, soil conditions, and topography
 - 8.1.4.1.3.2 Diagram the water cycle, the nitrogen cycle, and the carbon-oxygen cycle
 - 8.1.5 Individuals and populations
 - 8.1.5.1 Discuss the concept of the individual: as an organism, as a part of a group such as a species or population, and in the light of the concept of biogenesis, a link between the past and the future
 - 8.1.5.2 Populations
 - 8.1.5.2.1 Distinguish between population and population density
 - 8.1.5.2.2 Give the method for measuring population density
 - 8.1.5.2.3 Give the procedure for measuring the rate of change in population density
 - 8.1.5.2.4 Give the effect on population density of such factors as mortality, natality, immigration, and emigration
 - 8.1.5.2.5 Explain the expressions "density dependent factors" and "density independent factors"
 - 8.1.5.2.6 Describe the difference in the growth patterns of a population in a closed system and one in an open system
 - 8.1.6 Species and species populations
 - 8.1.6.1 Define the term species
 - 8.1.6.2 Explain why the definition commonly used for species is inadequate
 - 8.1.6.3 List five ways in which nature seems to try to maintain the integrity of the species
- 8.2 The habitat
 - 8.2.1 Distinguish between the habitat of an organism and the niche of an organism
 - 8.2.2 List the factors which determine the geographic range of a species
 - 8.2.3 Tolerance
 - 8.2.3.1 Define the term tolerance
 - 8.2.3.2 Know what is meant by the terms, minimum tolerance, optimum tolerance, and maximum tolerance in reference to the ability of an organism to withstand conditions in the environment
 - 8.2.3.3 Explain how factors such as duration of a poor condition, the interaction of different factors, and the individual differences determine success or failure of an individual or a species to survive in any given environment
 - 8.2.4 Limiting factors of the environment
 - 8.2.4.1 Soil
 - 8.2.4.1.1 Name the three types of soil and name one kind of tree that would grow well in each type
 - 8.2.4.1.2 Know how the chemical content of soil determines the kinds of plants which grow there
 - 8.2.4.2 Temperature
 - 8.2.4.2.1 Define these terms: poikilothermic, homeiothermic, hibernation, and estivation
 - 8.2.4.2.2 Explain the advantage of: deciduous trees shedding their leaves, evergreens having small leaves and tapered shapes, and animals being able to migrate
 - 8.2.4.3 Water
 - 8.2.4.3.1 Distinguish among hydrophyte, mesophyte, and xerophyte plants as to habitat and structures for adaptation to their special environment
 - 8.2.4.3.2 Distinguish between aquatic and marine organisms
 - 8.2.4.4 Light
 - 8.2.4.4.1 List several adaptations that are common to plants that grow in reduced amounts of light
 - 8.2.4.4.2 Explain how organisms that live in darkness get energy from the sun

- 8.2.4.5 Oxygen
 - 8.2.4.5.1 Explain water turnover in bodies of water and why it is important to life in the deep areas of the body water
 - 8.2.4.5.2 Give the reason for boggy soils having a low oxygen content
- 8.2.4.6 Topography
 - 8.2.4.6.1 List four causes of change in the earth's topography
 - 8.2.4.6.2 List some effects a change in topography has on the life in the area where the change occurs
- 8.2.5 Habitats
 - 8.2.5.1 Land habitats
 - 8.2.5.1.1 Describe the microscopic and macroscopic organisms which might be found in a six inch square plot of grassy meadow soil
 - 8.2.5.1.2 Know how to set up a terrarium illustrating either a bog or a desert environment
 - 8.2.5.1.3 Plan a project in which a wooded plot or a meadow plot has been designated for careful study
 - 8.2.5.2 Water habitats
 - 8.2.5.2.1 Make a diagram to show the interaction of life in a small pond
 - 8.2.5.2.2 Name five animals common to water habitats and describe the water life which they consume
 - 8.2.5.2.3 Give instructions for setting up an aquarium with both plants and fish
 - 8.2.5.2.4 Describe four marine animals and plants
- 8.3 Periodic changes in the environment
 - 8.3.1 Periodic changes in the behavior of organisms
 - 8.3.1.1 Define circadian or innate rhythms
 - 8.3.1.2 Explain how leaf movements of plants or feeding habits of birds are indicative of innate rhythms in a natural environment
 - 8.3.1.3 Explain the reproduction of many animals and the flowering cycle of plants in the light of possible annual rhythms
 - 8.3.1.4 In the light of man's circadian rhythms, tell how a jet plane trip from San Francisco to London would affect him
 - 8.3.1.5 Why are circadian rhythms often referred to as "biological time clocks"
 - 8.3.2 Causative factors involved in periodicity
 - 8.3.2.1 Light-dark cycle
 - 8.3.2.1.1 Distinguish between diurnal and nocturnal organisms
 - 8.3.2.1.2 Describe some laboratory studies that have been made in order to learn about periodic behavior
 - 8.3.2.1.3 Give the scientific value in banding the legs of birds or marking animals for study in the natural environment
 - 8.3.2.2 Temperature
 - 8.3.2.2.1 Describe hibernation, estivation, and migration as ways of survival
 - 8.3.2.3 Seasonal or climatic changes
 - 8.3.2.3.1 List and discuss five ways in which animals meet seasonal changes
 - 8.3.2.3.2 List some of the adjustments animals must make for survival in very cold areas
 - 8.3.2.3.3 Select six animals common to your locality and make a report on the way each one meets the seasonal change
 - 8.3.2.3.4 Discuss the migrations of the Arctic tern and the golden plover
 - 8.3.2.3.5 List several ways by which plants are able to survive the seasonal changes
 - 8.3.2.4 Lunar rhythms which produce tides
 - 8.3.2.4.1 Describe the spawning of the grunion
 - 8.3.2.4.2 Give the effect of lunar periodicity on the reproductive cycles of the oyster, sea anemone, and many other marine organisms
 - 8.3.3 Territoriality
 - 8.3.3.1 Explain how territorial behavior seems to be an example of periodicity which has value in the survival of the species
 - 8.3.3.2 State the functions territorial behavior may have in the ecology of an individual
 - 8.3.3.3 Describe the territorial behavior of a male mocking bird from early spring to late summer or autumn
- 8.4 Biogeography
 - 8.4.1 Climatic belts of the earth
 - 8.4.1.1 Explain how the location of climatic belts of the earth depends on the intensity and seasonal distribution of solar energy
 - 8.4.2 Biomes
 - 8.4.2.1 Define the term biome

- 8.4.2.2 Explain why the natural biota of a biome is a direct reflection of the abiotic conditions that exist there
- 8.4.3 Major biomes of the earth that result from an increasing amount of radiant energy
 - 8.4.3.1 Tundra
 - 8.4.3.1.1 Locate the Tundra
 - 8.4.3.1.2 Describe abiotic conditions in winter and summer of the Tundra
 - 8.4.3.1.3 List some of the living things found in the Tundra
 - 8.4.3.2 Taiga
 - 8.4.3.2.1 Locate the Taiga
 - 8.4.3.2.2 Discuss the abiotic and the biotic environments in Taiga
 - 8.4.3.3 Middle latitude deciduous forest
 - 8.4.3.3.1 Locate the abiotic and biotic environments of the middle latitude deciduous forest
 - 8.4.3.3.2 Describe the abiotic and biotic environments of the middle latitude deciduous forest
 - 8.4.3.4 Tropical rain forest
 - 8.4.3.4.1 Locate the trees, lianas, epiphytes, aboreal animal life, and life of the ground in the tropical rain forest
- 8.4.4 Biomes resulting from decreasing precipitation
 - 8.4.4.1 The Tropics
 - 8.4.4.1.1 Locate the Tropics
 - 8.4.4.1.2 Describe the abiotic and biotic factors of the Tropics
 - 8.4.4.1.3 Know some adjustments made by the plants and animals of the Tropics to the wet and dry seasons
 - 8.4.4.2 Savannas
 - 8.4.4.2.1 Locate the abiotic and biotic environments of the savannas
 - 8.4.4.2.2 Describe the abiotic and biotic environments of the savannas
 - 8.4.4.3 Grass lands
 - 8.4.4.3.1 Locate the great grass lands of North America, South America, and Africa
 - 8.4.4.3.2 Give the name of each great grass land of North America
 - 8.4.4.3.3 Describe three of the interesting animals of the grass lands
 - 8.4.4.3.4 Know what happened to the American bison
 - 8.4.4.3.5 Describe the problems in the African veldt today
 - 8.4.4.4 The deserts
 - 8.4.4.4.1 Locate the great deserts of the earth
 - 8.4.4.4.2 Describe the abiotic conditions of a desert
 - 8.4.4.5 West Coast biomes
 - 8.4.4.5.1 Discuss the middle latitude rain forest of Western North America which extends from northern California to Alaska
 - 8.4.4.5.2 Discuss the chaparral of southern California
- 8.4.5 Interactions between organisms of various biomes
 - 8.4.5.1 Dispersal
 - 8.4.5.1.1 Define: dispersal, dispersal routes, corridor, filter route, barriers, and sweepstakes dispersal
 - 8.4.5.1.2 List at least five ways in which the seeds of plants are adapted for dispersal
 - 8.4.5.1.3 List at least five kinds of barriers to dispersal
- 8.4.6 Problems in water environments
 - 8.4.6.1 Name the special problems of intertidal zones
 - 8.4.6.2 Know how the organisms meet the problems of intertidal zones
 - 8.4.6.3 Describe how the organisms in the very deep water solve the problems of securing the essentials of life
 - 8.4.6.4 Explain why organisms can live at the bottom of a lake even when the surface is frozen over
 - 8.4.6.5 Discuss the salinity and thermal barriers in the sea
- 8.5 Conservation of natural resources
 - 8.5.1 Soil and water conservation
 - 8.5.1.1 Soil origin and types
 - 8.5.1.1.1 Define the term soil
 - 8.5.1.1.2 Explain the role of the forces of weathering in the breaking of rock into soil
 - 8.5.1.1.3 Describe the properties of the three classes of soil
 - 8.5.1.1.4 Define the term humus
 - 8.5.1.1.5 Give the importance of humus to soil
 - 8.5.1.1.6 Distinguish between residual and transported soils
 - 8.5.1.2 Erosion - the movement of soil
 - 8.5.1.2.1 Define the term erosion
 - 8.5.1.2.2 Describe two forces that cause erosion
 - 8.5.1.2.3 Discuss running water as a major cause of soil erosion
 - 8.5.1.2.4 Discuss problems resulting from erosion, such as washing away of topsoil, gully formation, leaching of chemicals resulting in loss of soil fertility, and blocking of drainage systems

- 8.5.1.3 Water and related problems
 - 8.5.1.3.1 Review the water cycle and relate it to water conservation
 - 8.5.1.3.2 Define the term watershed
 - 8.5.1.3.3 Diagram the drainage system of a river
 - 8.5.1.3.4 Discuss the problems of flooding, back water, and drought
 - 8.5.1.3.5 Explain the close relationship between soil erosion and flooding by streams
- 8.5.1.4 Corrective methods used to conserve soil and water
 - 8.5.1.4.1 Close relationship between agriculture and the water cycle
 - 8.5.1.4.1.1 Explain how loss of soil can be decreased by use of row crops, cover crops, terracing, contour plowing, and strip planting
 - 8.5.1.4.1.2 Define the term leaching
 - 8.5.1.4.1.3 Know how loss of fertility can be corrected
 - 8.5.1.4.1.4 State the value of crop rotation
 - 8.5.1.4.1.5 Outline a workable plan of crop rotation over a four year period using corn, wheat, oats, and clover; justify the use of each crop in the sequence listed
 - 8.5.1.4.2 Erosion control
 - 8.5.1.4.2.1 Devise a plan for stopping erosion in a large gully
 - 8.5.1.4.2.2 List several ways by which wind erosion can be controlled
 - 8.5.1.4.2.3 List some ways by which flooding may be controlled
 - 8.5.1.4.2.4 Tell how a forest area along a stream might help in water and soil conservation
- 8.5.1.5 Plan a model showing soil erosion and one showing the same area after correct methods of conservation have restored it
- 8.5.2 Forest and wild life conservation
 - 8.5.2.1 Forests
 - 8.5.2.1.1 Define the term forest
 - 8.5.2.1.2 Discuss a forest as a plant and animal community dominated by trees
 - 8.5.2.1.3 Know how a forest affects climate, stores water, furnishes valuable products to man, provides recreation, and inspires man by its aesthetic beauty
 - 8.5.2.1.4 Locate the five major forest areas of the United States
 - 8.5.2.1.5 Name the predominant kinds of trees in each of the five major forest areas of the United States
 - 8.5.2.1.6 Give the names and the valuable products of the forest trees in your local area
 - 8.5.2.1.7 Causes of forest destruction
 - 8.5.2.1.7.1 Forest fires
 - 8.5.2.1.7.1.1 Discuss at least five causes of forest fires
 - 8.5.2.1.7.1.2 List some ways forest fires can be prevented
 - 8.5.2.1.7.1.3 Explain how forest rangers locate a forest fire and name some methods they use to fight it
 - 8.5.2.1.7.2 Describe some results of uncontrolled lumbering
 - 8.5.2.1.7.3 Report on the activities of these insects: sawfly, bark beetle, pine beetle, boring beetles, gypsy and browntail moths, and the tent caterpillar
 - 8.5.2.1.7.4 List tree diseases caused by rusts and fungi
 - 8.5.2.1.8 Effects of forest destruction
 - 8.5.2.1.8.1 Explain how the lowering of the water table affects the forest ponds, lakes, and streams
 - 8.5.2.1.8.2 Know how the animal populations are affected by the clearing of forest lands
 - 8.5.2.1.9 Forest conservation practices
 - 8.5.2.1.9.1 Define: improvement cutting, block cutting, clear cutting, and controlled burning
 - 8.5.2.1.9.2 Reforestation can be done by several methods; describe two of them
 - 8.5.2.1.9.3 Describe the work done by the federal, state, district, and local agencies involved in forest conservation and management
- 8.5.2.2 Wild life conservation
 - 8.5.2.2.1 Distinguish between restocking and relocating wild life
 - 8.5.2.2.2 State the value of a fish ladder in fish conservation
 - 8.5.2.2.3 Explain what is meant by productive ponds, lakes, and streams

- 8.5.2.2.4 Discuss the effects of various insecticides and herbicides on the health conditions of wild life
- 8.5.2.2.5 Describe the work done by federal and state wild life federations in wild life conservation
- 8.5.2.2.6 Describe the conditions of wild life in your area
- 8.5.2.3 Forests and wild life are natural resources
 - 8.5.2.3.1 The forest as a natural resource
 - 8.5.2.3.1.1 Explain how the forest is a renewable resource
 - 8.5.2.3.1.2 Discuss the multiple-use concept of the forest
 - 8.5.2.3.2 Discuss wild life as a source of food, recreation, livelihood, hobby, and as a source of inspiration and beauty
- 8.6 Man in the biosphere
 - 8.6.1 Discuss stone age man's ecological niche
 - 8.6.2 Name some physical characteristics that have enabled man to rise from being just a member of the community to the maker of communities
 - 8.6.3 Explain the effect the use of fire and the discovery of the wheel have on man's position in the biosphere
 - 8.6.4 Name the ways in which the city is the most artificial of all environments
 - 8.6.5 Explain why it is difficult for many urban people to realize that man is a part of the biosphere and has an important place in the Web of Life
 - 8.6.6 Discuss such modern problems as: disease and death, over population, pollution of air, water, and soil, scarcity of food, energy, and room, and leisure time because of shorter work days
 - 8.6.7 State how man's ecological problems are closely related to the ecological problems of conservation of land, water, forests, and wild life
 - 8.6.8 Explain how man is interrelated with and interdependent upon every other living thing and the abiotic world in which he lives
 - 8.6.9 Explain why it is important that each individual realize that he is a part of the Web of Life and is responsible for its well being

MARINE BIOLOGY

1.0 INTRODUCTION TO A MARINE ENVIRONMENT

- 1.1 Historical oceanography
 - 1.1.1 Identify several pioneers that made important contributions to the history of oceanography
 - 1.1.2 Describe significant events that led to the development of oceanography
 - 1.1.3 Name and locate the major oceans
- 1.2 Gulf of Mexico
 - 1.2.1 Discuss the various geological periods
 - 1.2.2 Describe the shape and location
 - 1.2.3 Discuss the Fertile Fisheries Crescent
- 1.3 Mississippi Sound
 - 1.3.1 Define a sound
 - 1.3.2 Give the boundaries of the Mississippi Sound
 - 1.3.3 Give a description of the islands comprising the Mississippi Sound
 - 1.3.4 Characteristics of the Mississippi Sound
 - 1.3.4.1 Describe sandy beaches, including the characteristics, the formation, and the construction of a man-made beach
 - 1.3.4.2 Relate salinity variations
 - 1.3.4.3 Explain bottom types
 - 1.3.4.4 Discuss seasonal changes and their effects
 - 1.3.4.5 Discuss tides and tidal movements
 - 1.3.4.6 Discuss specific gravity, density, and pH
 - 1.3.4.7 Discuss waves, currents, turbulence, dissolved gases, and salts
 - 1.3.4.8 Illustrate yearly temperature variations

2.0 SIGNIFICANCE OF MARINE ECOLOGY

- 2.1 Define ecology
- 2.2 Discuss habitats and ecological niches
- 2.3 Explain the food chain, emphasizing the significance of the dinoflagellates and algae
- 2.4 Draw and discuss the food pyramid
- 2.5 Discuss environmental factors, including the physical factors, chemical factors, and human factors
- 2.6 Discuss the migrations and reasons for migrations of several marine species
- 2.7 Give examples of symbiosis including commensalism, mutualism, and parasitism
- 2.8 Prepare several graphs demonstrating birth rate, growth, population density, and mortality rate
- 2.9 Discuss biotic potential and environmental resistance
- 2.10 Compare a fresh water environment with a salt water environment

3.0 DESCRIPTION OF TIDES

- 3.1 Discuss the causes of tides
- 3.2 Explain the types of tides, including semidiurnal, diurnal, mixed, and solar tide
- 3.3 Describe the tides on the Mississippi Coast
- 3.4 Discuss some major currents and their effects
- 3.5 Hurricanes
 - 3.5.1 Discuss the causes of hurricanes
 - 3.5.2 Locate the area where hurricanes originate
 - 3.5.3 Discuss the effects of hurricanes on marine organisms

4.0 INTRODUCTION TO MARINE ORGANISMS

- 4.1 Plankton
 - 4.1.1 Define the term plankton
 - 4.1.2 List two basic types of plankton and give examples of each
 - 4.1.3 Relate the growth rate of plankton to environmental factors
 - 4.1.4 Discuss the importance of plankton in the food chain
- 4.2 Autotrophic organisms
 - 4.2.1 Define the term autotrophic organism
 - 4.2.2 Give the significance of the marine and brackish water autotrophs
 - 4.2.3 Identify and discuss the importance of the shoreline plants
- 4.3 Marine phyla
 - 4.3.1 Protozoa
 - 4.3.1.1 Give classification and phylum characteristics of protozoa
 - 4.3.1.2 Discuss significant representatives in the phylum
 - 4.3.1.3 Discuss the significance of plankton blooms
 - 4.3.2 Porifera
 - 4.3.2.1 Give classification and phylum characteristics of porifera
 - 4.3.2.2 Identify and discuss representatives of the three classes of porifera
 - 4.3.2.3 Discuss the relationship of structure and function within the phylum
 - 4.3.3 Coelenterata
 - 4.3.3.1 Give classification and phylum characteristics of coelenterata
 - 4.3.3.2 Identify and discuss representatives of the three classes of coelenterata
 - 4.3.3.3 Discuss an organism exhibiting metagenesis

- 4.3.4 Ctenophora
 - 4.3.4.1 Give classification and phylum characteristics
 - 4.3.4.2 Identify and discuss local representatives of the phylum
 - 4.3.4.3 Compare Ctenophores with Ctenophores
 - 4.3.4.4 Discuss the life cycle of ctenophora
- 4.3.5 Platyhelminthes
 - 4.3.5.1 Give classification and phylum characteristics of platyhelminthes
 - 4.3.5.2 Relate several life histories of species within the phylum illustrating symbiotic relationships
- 4.3.6 Aschelminthes
 - 4.3.6.1 Give classification and phylum characteristics of aschelminthes
 - 4.3.6.2 Describe several organisms involving marine organisms as hosts
- 4.3.7 Annelida
 - 4.3.7.1 Give classification and phylum characteristics of annelida
 - 4.3.7.2 Compare annelids with other worms
 - 4.3.7.3 Discuss the significance of the trochophore larva
 - 4.3.7.4 Discuss the ecological niches and feeding habits and life cycles of annelids
- 4.3.8 Mollusca
 - 4.3.8.1 Give classification and phylum characteristics of mollusca
 - 4.3.8.2 Name representatives from each class within the phylum
 - 4.3.8.3 Compare the three major classes of mollusk
 - 4.3.8.4 Discuss the life cycles of the economically important species within the phylum
 - 4.3.8.5 Discuss the significance of the veliger larva
 - 4.3.8.6 Discuss methods of locomotion of various representatives of mollusca during their life cycles
 - 4.3.8.7 Compare the feeding habits of various representatives of mollusk
 - 4.3.8.8 Discuss unusual features of the mollusk including radula, ink sac, chromatophores, eyes, torsion, and shell formation
- 4.3.9 Bryozoa (Ectoprocta)
 - 4.3.9.1 Give classification and phylum characteristics of bryozoa
 - 4.3.9.2 Discuss the anatomy and physiology of a bryozoan
 - 4.3.9.3 Distinguish several forms of bryozoans
- 4.3.10 Arthropoda
 - 4.3.10.1 Give classification and phylum characteristics of arthropoda
 - 4.3.10.2 Compare Crustacea with other classes in this phylum
 - 4.3.10.3 Explain how the theory of "ontogeny recapitulates phylogeny" can be illustrated by some crustaceans in their life cycles
 - 4.3.10.4 Identify larval forms
 - 4.3.10.5 Recognize the importance of crustaceans in plankton
 - 4.3.10.6 Relate the significance of salinity and temperature variation on the life cycle of crustaceans
 - 4.3.10.7 Name crustaceans of economic importance
 - 4.3.10.8 Explain why the horseshoe crab is known as a living fossil
 - 4.3.10.9 Distinguish among the three species of shrimp used commercially
 - 4.3.10.10 Discuss the life cycle and economic importance of the blue crab
 - 4.3.10.11 Discuss gear and equipment for collecting commercially important species
 - 4.3.10.12 Discuss molting
 - 4.3.10.13 Identify shore arthropods
- 4.3.11 Chaetognatha
 - 4.3.11.1 Describe and give importance in plankton
- 4.3.12 Echinodermata
 - 4.3.12.1 Give classification and phylum characteristics of echinodermata
 - 4.3.12.2 Compare the embryological development of the echinoderms with other phyla
 - 4.3.12.3 Describe the water-vascular system of echinodermata
 - 4.3.12.4 Explain autotomy in relation to species of echinodermata
 - 4.3.12.5 Identify representative forms of echinodermata
 - 4.3.12.6 Compare the feeding habits of members of the various classes of echinodermata
 - 4.3.12.7 Explain why echinoderms are abundant in fossils
 - 4.3.12.8 Explain how man is responsible for the decline in population of echinoderms
- 4.3.13 Chordata
 - 4.3.13.1 Give classification and phylum characteristics of chordata
 - 4.3.13.2 Distinguish the lower chordates from the vertebrates
 - 4.3.13.3 List the classes of vertebrates in their correct evolutionary sequence and give the distinguishing characteristics of each
 - 4.3.13.4 Identify cartilaginous fish from the Mississippi Sound and the Mississippi Gulf Coast area
 - 4.3.13.5 Describe the reproduction methods of the cartilaginous fish
 - 4.3.13.6 Discuss the anatomy and physiology of the cartilaginous fish
 - 4.3.13.7 Discuss toxicity of vertebrates
 - 4.3.13.8 Describe various forms of scales of fishes
 - 4.3.13.9 Give the distinguishing characteristics of some of the most abundant families of fish

- 4.3.13.10 Describe some unusual modifications of organs including light and electricity production, formation of suction disc, and migration of eyes of flat fish
- 4.3.13.11 Describe reproduction and life cycles of some of the most common bony fishes
- 4.3.13.12 Discuss the role of fish in the food chain
- 4.3.13.13 Identify and discuss fish of economic importance to the state
- 4.3.13.14 Compare different habitats of fishes
- 4.3.13.15 Discuss and give examples of various symbiotic relationships in fishes
- 4.3.13.16 Discuss and identify methods and equipment used in catching fish
- 4.3.13.17 Compare the feeding habits of representative fish
- 4.3.13.18 Discuss the amphibians of the Mississippi coastal area
- 4.3.13.19 Describe the reptiles which are typical of the Mississippi coastal region
- 4.3.13.20 Describe the significance of the reproductive habits of the sea turtles
- 4.3.13.21 Identify the major groups of marine birds, giving examples
- 4.3.13.22 Discuss various adaptations which fit the bird for its particular habitat
- 4.3.13.23 Discuss the position of birds in the food chain
- 4.3.13.24 Compare the poikilothermic and homiothermic characteristics of vertebrates
- 4.3.13.25 Discuss the representative cetaceans of the area
- 4.3.13.26 Explain how these mammals are adapted to the marine environment
- 4.3.13.27 Discuss the mammal protection law

5.0 ECONOMIC SIGNIFICANCE OF THE GULF COAST REGION

- 5.1 Discuss how the seafood industry affects the economy of the state
- 5.2 Relate how temperature, salinity and other factors can affect this economy
- 5.3 Prepare graphs illustrating fluctuations of seafood harvest
- 5.4 Discuss the laws that govern the seafood harvest
- 5.5 Explain those factors that govern the harvest season
- 5.6 Explain how individuals could contribute to the improvement of the economy
- 5.7 Prepare a graph illustrating income from various aspects of the seafood industry

6.0 CAREERS IN AND RELATED TO MARINE BIOLOGY

- 6.1 List career fields relating to the marine sciences
- 6.2 Explain how one becomes a licensed boat operator
- 6.3 Discuss current research being conducted by marine biologists in research programs in Mississippi
- 6.4 Name and locate major marine laboratories in the United States
- 6.5 Identify universities which offer a major in marine biology

7.0 PROBLEMS OF POLLUTION

- 7.1 Define pollution
- 7.2 Discuss types of pollution affecting marine organisms
- 7.3 Explain how filling the marshlands is detrimental to marine organisms
- 7.4 Discuss how pollution is determined
- 7.5 Discuss the laws pertaining to marine pollution
- 7.6 Discuss the effect of pollution on the future of man
- 7.7 Cite instances of marine pollution
- 7.8 Name local, state and federal agencies that are responsible for testing for pollution

8.0 PROSPECTS OF FUTURE MARINE TECHNOLOGY

- 8.1 Explain how marine organisms may be grown under controlled conditions
- 8.2 Compare mariculture methods used by other countries
- 8.3 Explain how man may develop other resources from the sea
- 8.4 Explain how revisions in international law must come about to insure the protection of marine resources
- 8.5 Discuss the necessity of cooperation in the conservation of marine resources
- 8.6 Discuss man's future role in the prevention of overfishing

EARTH AND SPACE SCIENCE

HIGH SCHOOL

1.0 PHYSICAL GEOLOGY

1.1 Matter and energy

1.1.1 Theories and laws

- 1.1.1.1 Describe the atomic theories of Dalton, Thompson, Rutherford-Bohr, and quantum mechanical
- 1.1.1.2 State the Law of Conservation of Matter and Energy
- 1.1.1.3 Describe the laws governing magnetism

1.1.2 Matter

- 1.1.2.1 Describe the structure of an atom including charge, size, and position of atomic particles
- 1.1.2.2 Construct a diagram showing the shells and sub-shells where electrons are found
- 1.1.2.3 List the states of matter and write a brief description of each
- 1.1.2.4 List four properties of matter
- 1.1.2.5 Balance several chemical equations

1.1.3 Energy

- 1.1.3.1 Show how solar energy may be collected and used
- 1.1.3.2 Explain how nuclear energy can be harnessed
- 1.1.3.3 Give the location of present and potential geothermal areas
- 1.1.3.4 Calculate and graph depth versus heat curves for areas of the earth
- 1.1.3.5 Relate the scientific method to the search for energy sources

1.2 Lithology

1.2.1 Mineralogy

1.2.1.1 Composition

- 1.2.1.1.1 Make a circle graph of the eight predominant elements in the earth's crust and give the chemical symbol for each
- 1.2.1.1.2 Name three elements found in the pure, uncombined state and give the chemical symbol for each
- 1.2.1.1.3 Given a list of formulas, for common minerals, identify the mineral and specify the amount of each element present
- 1.2.1.1.4 Diagram the chemical bonding of sodium and chlorine to form halite

1.2.1.2 Structure

- 1.2.1.2.1 Explain the difference between crystalline and amorphous
- 1.2.1.2.2 Explain the relationship between rate of cooling and crystal size
- 1.2.1.2.3 Name the six crystal systems and describe their axes as to number, relative lengths, and angular relationships
- 1.2.1.2.4 Give a mineral example for each system of crystals
- 1.2.1.2.5 Describe these mineral habits: acicular, micaceous, botryoidal
- 1.2.1.2.6 Explain why the term molecule is not useful in describing a mineral
- 1.2.1.2.7 Describe a quartz crystal and explain the conditions which allowed this formation
- 1.2.1.2.8 Explain why minerals with the same chemical composition, such as diamond and graphite, exhibit such varying properties
- 1.2.1.2.9 List the two main factors that control which ions can become part of the crystal structure of a particular mineral
- 1.2.1.2.10 Distinguish among granular, compact, and earthy
- 1.2.1.2.11 Discuss whether or not coral and an ice cube could be classified as minerals

1.2.1.3 Identification

- 1.2.1.3.1 Correlate the Mohs' hardness scale with the field scale for hardness
- 1.2.1.3.2 Given a set of minerals, determine the relative hardness by performing the scratch test
- 1.2.1.3.3 List five factors which influence the hardness of different mineral specimens
- 1.2.1.3.4 Explain why minerals may vary from one specimen to another and discuss why color is not a very reliable property in identifying minerals
- 1.2.1.3.5 Describe two methods for obtaining a streak and explain why streak by itself cannot be used to identify a mineral
- 1.2.1.3.6 Explain cleavage, list three types of cleavage planes, and name a mineral example of each
- 1.2.1.3.7 Explain the difference between cleavage planes and crystal faces
- 1.2.1.3.8 Distinguish between fracture and cleavage and describe three types of fractures

- 1.2.1.3.9 Explain what is meant by luster and list the two broad classes
- 1.2.1.3.10 Distinguish among resinous, vitreous, and adamantine
- 1.2.1.3.11 Determine the specific gravity of several common minerals and compare these results to heft
- 1.2.1.3.12 Exhibit an understanding of the following: sectile, brittle, ductile, malleable, flexible, and elastic
- 1.2.1.3.13 Identify two minerals exhibiting magnetic properties
- 1.2.1.3.14 Explain the difference between fluorescence and phosphorescence
- 1.2.1.3.15 When cold, dilute hydrochloric acid is dropped on several mineral samples, explain what happens to carbonates
- 1.2.1.3.16 Describe three tests to identify minerals using a flame and identify three elements based on flame color
- 1.2.1.4 Rock-forming minerals
 - 1.2.1.4.1 Construct and describe a silicon-oxygen tetrahedron
 - 1.2.1.4.2 List two ferromagnesian and identify significant characteristics of each
 - 1.2.1.4.3 List two nonferromagnesian and cite a significant characteristic of each
 - 1.2.1.4.4 Explain how oxide minerals are formed and identify three oxide minerals by chemical formula
 - 1.2.1.4.5 List three metals obtained from oxide ores and discuss extraction and processing practices
 - 1.2.1.4.6 Explain how sulfide minerals are formed and name three metals found in combination with sulfur
 - 1.2.1.4.7 Contrast carbonates and silicates
 - 1.2.1.4.8 Explain the chemical composition of sulfates
 - 1.2.1.4.9 Give a common example of a carbonate and a sulfate mineral
 - 1.2.1.4.10 Diagram earth processes which are conducive to accumulation of metallic ores
 - 1.2.1.4.11 Indicate the geophysical methods used to locate ore deposits
 - 1.2.1.4.12 Name five important nonmetallic ores and specify a use for each
 - 1.2.1.4.13 Given a map, plot the major geographic locations of non-metallic ores

1.8 Petrology

1.3.1 Igneous rocks

- 1.3.1.1 Identify the primary rock-forming minerals making all igneous rocks
- 1.3.1.2 Contrast the formation of various igneous rocks
- 1.3.1.3 Explain Bowen's reaction series
- 1.3.1.4 Distinguish among coarse-grained, fine-grained, glassy, pyroclastic, and porphyritic textures; give an example for each
- 1.3.1.5 Explain how sialic rocks differ from sima rocks
- 1.3.1.6 Tell why basalt is called trap rock
- 1.3.1.7 Differentiate between porphyritic and pegmatite rocks
- 1.3.1.8 Distinguish between tabular plutons and massive plutones; give an example of each and specify whether each is concordant or discordant

1.3.2 Sedimentary rocks

- 1.3.2.1 State the most significant feature of sedimentary rock
- 1.3.2.2 Compare the formation of sedimentary rocks to igneous rocks as to depth, temperature, and pressure
- 1.3.2.3 List the products of weathering which become the raw materials of sedimentary rocks
- 1.3.2.4 Name the three most common minerals found in sedimentary rocks
- 1.3.2.5 Explain how detrital sedimentary rocks differ from chemical sedimentary rocks
- 1.3.2.6 Discuss how a biochemical rock is formed and give an example
- 1.3.2.7 Distinguish among marine rock, fluvial rock, and lacustrine rock
- 1.3.2.8 Explain the relationship of deposition to lithification
- 1.3.2.9 Distinguish between clastic and nonclastic texture
- 1.3.2.10 Describe three lithification processes
- 1.3.2.11 Name the three most common sedimentary rocks
- 1.3.2.12 Show by diagrams the difference between horizontal bedding and inclined bedding
- 1.3.2.13 Distinguish between ripple marks and mud cracks
- 1.3.2.14 Identify nodules, concretions, and geodes
- 1.3.2.15 Explain what is meant by sedimentary facies
- 1.3.2.16 Specify the most important source of color in sedimentary rocks

1.3.3 Metamorphic rocks

- 1.3.3.1 Explain the difference between regional metamorphism and contact metamorphism
- 1.3.3.2 List the three agents of metamorphism
- 1.3.3.3 Explain how each agent of metamorphism alters the texture and composition

- 1.3.3.4 Distinguish between foliated and unfoliated texture
- 1.3.3.5 Name six common metamorphic rocks and identify the rock from which each formed
- 1.4 Geomorphology
 - 1.4.1 Weathering of rocks
 - 1.4.1.1 Describe three agents of mechanical weathering and explain why mechanical weathering is also referred to as disintegration
 - 1.4.1.2 Describe three agents of chemical weathering and explain why chemical weathering is also referred to as decomposition
 - 1.4.1.3 List the two principal factors which control the speed and the way in which a rock weathers
 - 1.4.1.4 Explain what is meant by differential weathering
 - 1.4.1.5 Explain the relationship of rate to particle size, temperature, and moisture
 - 1.4.2 Pedology
 - 1.4.2.1 Explain the energy system of the land-atmosphere interface in the process of soil formation
 - 1.4.2.2 List organic and inorganic components of soil
 - 1.4.2.3 Discuss the importance of colloids in soil formation
 - 1.4.2.4 Explain how the horizons in soil profile differ and explain how a mature soil evolves
 - 1.4.2.5 Discuss why soils differ in color
 - 1.4.2.6 Given the rate of weathering for a particular rock type, compute the time it would take to form one meter of soil
 - 1.4.2.7 Name the four main soil types based on texture and state a significant characteristic of each
 - 1.4.2.8 Name three major soil types based on climatic conditions
 - 1.4.2.9 Given a map of the United States, designate the areas of these soil types: forest, grasslands, and desert
 - 1.4.2.10 Explain how soil types reflect the climatic categories, humid, sub-humid, and arid
 - 1.4.2.11 Explain the pH test to determine whether soil samples are pedalfers or pedocals
 - 1.4.2.12 List the agents of erosion according to their importance
 - 1.4.2.13 Note factors influencing the rate of erosion
 - 1.4.2.14 Explain how each of the following aids in the conservation of soil: contour plowing, crop rotation, terracing, strip cropping, forestry, cover crops, and grass coverage on slopes
 - 1.4.2.15 List two methods of reclaiming depleted soil
 - 1.4.2.16 Identify federal, state, and local conservation agencies and give the function of each
 - 1.4.3 Landforms
 - 1.4.3.1 Name the four types of landforms
 - 1.4.3.2 Identify the two groups of plains
 - 1.4.3.3 Cite two reasons why plains are more densely populated than other landforms
 - 1.4.3.4 Explain what is meant by local relief
 - 1.4.3.5 Distinguish among intermontane plateaus, piedmont plateaus, and continental plateaus
 - 1.4.3.6 List two important resources of hills
 - 1.4.3.7 Explain how geosynclines become mountain ranges
 - 1.4.3.8 Diagram effects of stresses to produce folds and faults
 - 1.4.3.9 Describe types of folds and faults
 - 1.4.3.10 Diagram and date mountain types
 - 1.4.3.11 Explain mountain influences on temperature and precipitation
 - 1.4.3.12 Describe the constructive and destructive forces that alter landscape
 - 1.4.3.13 Topography
 - 1.4.3.13.1 List three ways by which the configuration of the land is represented on topographic maps
 - 1.4.3.13.2 Construct a topographic profile
 - 1.4.3.13.3 Interpret a topographic map
 - 1.4.3.13.4 Describe five factors involved in map-making
 - 1.4.3.13.5 List five useful rules that apply to contour lines
 - 1.4.3.13.6 Describe two important surveying instruments
- 1.5 Earth's interior
 - 1.5.1 Spheres
 - 1.5.1.1 Distinguish among the crust, mantle, outer core, and inner core as to their thickness and composition
 - 1.5.1.2 Recognize the possibility of other layers not yet delineated
 - 1.5.2 Methods of interpretation
 - 1.5.2.1 Determine the relationship of density and distance on gravity readings and interpretation on earth materials
 - 1.5.2.2 Indicate attraction from magnetic or paramagnetic materials
 - 1.5.2.3 Explain the significance of depths of interfaces to magnetism
 - 1.5.3 Seismology
 - 1.5.3.1 Show that seismic waves are used to obtain information

- 1.5.3.2 Discuss the controlling factors of seismology
- 1.5.3.3 Explain the causes of seismic waves
- 1.5.3.4 Distinguish between focus and epicenter
- 1.5.3.5 Explain how intensity and magnitude differ
- 1.5.3.6 Explain how the time of earthquake occurrence is determined
- 1.5.4 Igneous activity
 - 1.5.4.1 Extrusive
 - 1.5.4.1.1 Identify the types of volcanoes
 - 1.5.4.1.2 Explain the sources of heat which cause magma; include graphs of radioactive elements with decay rates
 - 1.5.4.1.3 Differentiate between acidic and basic lava flows
 - 1.5.4.1.4 Map the geographic locations of volcanic activity and describe the probable reasons
 - 1.5.4.2 Intrusive
 - 1.5.4.2.1 Name the different types of intrusions
 - 1.5.4.2.2 Discuss isotacy and its association with oceans and continents
 - 1.5.4.2.3 Recognize convection currents and their relationship with the crystallization of minerals
- 1.5.5 Continental drift
 - 1.5.5.1 Demonstrate how continents fit together as a jigsaw puzzle
 - 1.5.5.2 Tell of paleomagnetism and the shifting of the magnetic poles
 - 1.5.5.3 Show fossil evidence of connected land masses and of only relatively young sediments in seas
 - 1.5.5.4 Map tectonic plates and show motion and effect
 - 1.5.5.5 Evaluate positions for and against the theory of continental drift

2.0 HISTORICAL GEOLOGY

- 2.1 Origin of the earth
 - 2.1.1 Explain why any theory of earth origin depends upon astronomy concepts
 - 2.1.2 Explain what is meant by time and tell how relative time differs from measured time
- 2.2 Evolution
 - 2.2.1 Explain the following factors of evolution: inheritance of acquired characteristics, natural selection, and mutations
 - 2.2.2 List three evidences of evolution and give an example of each
 - 2.2.3 State the biogenetic law and discuss how it operates
 - 2.2.4 Distinguish among analogous, vestigial, and homologous structures
- 2.3 Fossils
 - 2.3.1 List two necessary conditions for the formation of fossils
 - 2.3.2 Describe four environments favoring preservation and give a type of ancient life found in each
 - 2.3.3 Describe three principle modes of fossilization
 - 2.3.4 Distinguish among permineralization, replacement, and carbonation
 - 2.3.5 Explain the difference between a mold and a cast
 - 2.3.6 Distinguish between paleobotany and paleozoology
- 2.4 Interpretation of geologic history
 - 2.4.1 The geologic record
 - 2.4.1.1 Show the relationship of a columnar section to a geologic column
 - 2.4.1.2 Explain the law of superposition
 - 2.4.1.3 Explain the law of faunal succession
 - 2.4.1.4 Discuss what is meant by unconformities and distinguish among disconformity, nonconformity, and angular unconformity
 - 2.4.2 Geologic time
 - 2.4.2.1 Describe three methods used to calculate the length of geologic time
 - 2.4.2.2 Describe how uranium and Carbon-14 are useful in dating matter
 - 2.4.2.3 Discuss the law of intrusion
 - 2.4.2.4 Explain the subdivisions of geologic time
 - 2.4.2.5 Distinguish between paleogeography and paleoclimatology
 - 2.4.3 Correlation
 - 2.4.3.1 Explain three difficulties of correlation
 - 2.4.3.2 Describe three means of correlation
 - 2.4.3.3 Explain the importance of index fossils
 - 2.4.4 Pre-Cambrian eras
 - 2.4.4.1 Identify the Pre-Cambrian eras
 - 2.4.4.2 Name two types of occurrence by which Pre-Cambrian are exposed and identify the largest exposure of Pre-Cambrian rocks in North America
 - 2.4.4.3 Name three main mineral resources of Pre-Cambrian age
 - 2.4.4.4 Describe the most significant aspect of Pre-Cambrian climate
 - 2.4.4.5 Discuss Pre-Cambrian fossils
 - 2.4.5 Paleozoic era
 - 2.4.5.1 Describe three major structural features which dominated the physical geography of North America
 - 2.4.5.2 Describe three orogenies
 - 2.4.5.3 Describe the formation and types of fossil fuels and specify the most important mineral resource of this era

- 2.4.5.4 Explain the climatic significance of the coal swamps, coral and deserts of this era
- 2.4.5.5 Describe the plant and animal life of the Paleozoic era
- 2.4.6 Mesozoic era
 - 2.4.6.1 Name the three periods of the Mesozoic era
 - 2.4.6.2 Explain why ammonites make excellent index fossils
 - 2.4.6.3 Identify the most famous of the Cretaceous chalk beds
 - 2.4.6.4 Discuss climatic changes during this era
 - 2.4.6.5 Identify the dominant type of vegetation
 - 2.4.6.6 Name the most characteristic type of animal life
 - 2.4.6.7 Describe three distinct groups of animal life
 - 2.4.6.8 Name two chief mineral resources
 - 2.4.6.9 Identify and locate three major orogenies
 - 2.4.6.10 Describe the early mammals of the Mesozoic era
- 2.4.7 Cenozoic era
 - 2.4.7.1 Name the periods and epochs of the Cenozoic era
 - 2.4.7.2 Discuss the major changes in landscape of the Cenozoic era
 - 2.4.7.3 Identify two valuable mineral resources
 - 2.4.7.4 Discuss continental glaciation and explain the effects on surface water, soil, climate, and sea level
 - 2.4.7.5 Identify the most significant plants
 - 2.4.7.6 Trace the evolution of the horse
 - 2.4.7.7 Identify Cro-Magnon

3.0 HYDROLOGY

- 3.1 Nature of fresh water
 - 3.1.1 Recognize the source of water on earth and state where most fresh water is stored
 - 3.1.2 Explain the relationship of temperature to density
 - 3.1.3 Tell what is meant by surface tension
 - 3.1.4 Explain why water is recognized as the universal solvent
 - 3.1.5 Explain what happens to water when it freezes
 - 3.1.6 Compare the specific heat of liquid water to other naturally occurring substances
 - 3.1.7 Demonstrate the electrolysis of water
- 3.2 Surface water
 - 3.2.1 Explain what happens to moisture when it reaches the earth's surface
 - 3.2.2 Explain the meanings of the terms young, mature, and old as applied to streams and topography
 - 3.2.3 Identify stream gradient and explain how it affects the erosive power of a stream
 - 3.2.4 Distinguish among laminar flow, turbulent flow, and jet flow
 - 3.2.5 List two factors controlling stream velocity and explain how stream velocity is determined
 - 3.2.6 When given the channel width, depth, and water velocity, compute stream discharge
 - 3.2.7 Define the term base level
 - 3.2.8 List three conditions that may form a temporary base level
 - 3.2.9 Explain how a base level affects the stream profile
 - 3.2.10 List three kinds of work done by a stream
 - 3.2.11 List three ways in which a stream transports materials
 - 3.2.12 Distinguish between tributaries and distributaries
 - 3.2.13 Tell how delta formation differs from estuary formation
 - 3.2.14 List three valley features and compare narrow valleys to broad valleys
 - 3.2.15 Define the term limnology
 - 3.2.16 Explain how lakes are formed
 - 3.2.17 Explain the formation of seiche
 - 3.2.18 Determine the load of particles, in milligrams per liter, suspended in a particular water sample
 - 3.2.19 Identify the euphotic zone of a lake
 - 3.2.20 Describe these drainage patterns: dendritic, radial, and trellis
 - 3.2.21 List two factors controlling the life span of a lake
 - 3.2.22 Explain eutrophication of a lake
- 3.3 Ground water
 - 3.3.1 Distinguish between the zone of aeration and the zone of saturation
 - 3.3.2 Explain how capillary water differs from gravity water
 - 3.3.3 Compute an annual water budget when the monthly precipitation and evapotranspiration are given
 - 3.3.4 Distinguish among meteoric water, juvenile water, and connate water
 - 3.3.5 List two significant factors affecting the depth of the water table
 - 3.3.6 Make a series of sketches showing the stages in the formation of a sinkhole, a cavern, and a many-leveled cavern
 - 3.3.7 Explain how soil porosity and permeability are important controlling factors of infiltration

- 3.3.8 List three conditions that characterize an artesian system
- 3.3.9 Describe the formation of springs and geysers
- 3.3.10 Explain the difference between hard water and soft water

4.0. OCEANOGRAPHY

- 4.1 Sea water
 - 4.1.1 Distinguish between salinity and chlorinity
 - 4.1.2 List ways in which sea water differs from fresh water
 - 4.1.3 List two techniques by which salinity may be determined
 - 4.1.4 List the six elements which comprise ninety-nine percent of sea water and give the percentage of the two most abundant elements
 - 4.1.5 Given a world map, locate the oceans and show that they are a part of one continuous sea
 - 4.1.6 Relate latitude to surface salinity
 - 4.1.7 Recognize the three-principle properties of sea water
 - 4.1.8 Calculate water pressure for a given depth
 - 4.1.9 Interpret an isothermal map
 - 4.1.10 Explain why sodium chloride dissolves when put in water
 - 4.1.11 Compare the temperature of maximum density for fresh water with the temperature of maximum density in normal sea water
 - 4.1.12 Explain why sea water is referred to as brine
 - 4.1.13 Explain how to determine the dissolved oxygen content
 - 4.1.14 Discuss why the color of sea water varies
 - 4.1.15 Explain the principle of uniformity of composition
- 4.2 The ocean floor
 - 4.2.1 Explain why continents float higher than ocean basins
 - 4.2.2 Construct a profile of the ocean floor when given a table of depths recorded from numerous stations
 - 4.2.3 Describe two indirect means for obtaining information about crustal structure
 - 4.2.4 Name the two components of the continental margin and point out their similarities and differences
 - 4.2.5 Explain the relationship of turbidity currents to submarine canyons
 - 4.2.6 Describe sea-floor features included as part of the continental margins
 - 4.2.7 Describe sea-floor features included as part of the ocean basin
 - 4.2.8 List the conditions necessary for the growth of reef-building corals
 - 4.2.9 Diagram the stages in the transition from fringing reef to barrier reef to atoll
 - 4.2.10 Distinguish among lithogenous sediment, biogenous sediment, and hydrogenous sediment
- 4.3 The open ocean
 - 4.3.1 Distinguish among the surface zone, pycnocline, and deep zones
 - 4.3.2 List three major processes involved in the loss of heat from the surface zone
 - 4.3.3 Locate the thermocline by use of a model
- 4.4 waves, tides and currents
 - 4.4.1 Distinguish among crest, trough, wave height, wavelength, wave period, and wave base
 - 4.4.2 Compute wave speed when wavelength and period are known
 - 4.4.3 Specify significant differences between deep-water waves and shallow water waves
 - 4.4.4 Distinguish between storm waves and tidal waves
 - 4.4.5 Explain how hurricanes and waterspouts differ
 - 4.4.6 Explain what is meant by upwelling
 - 4.4.7 Relate the effects of upwelling on plankton
 - 4.4.8 Specify a general difference between the Northern Hemisphere gyre and the Southern Hemisphere gyre
 - 4.4.9 Explain what causes tides
 - 4.4.10 Explain the difference between spring tide and neap tide
 - 4.4.11 Discuss localities for the best development of strong tidal currents
 - 4.4.12 Compare spilling breakers to plunging breakers
 - 4.4.13 Explain the formation of a rip current
 - 4.4.14 Given a world map, indicate the major surface currents
 - 4.4.15 List three factors which determine how fast and how deep down water moves
 - 4.4.16 Explain what is meant by swells
 - 4.4.17 Describe the ways that energy gets into and leaves the water in the oceans
 - 4.4.18 Explain why a wave slows down as it nears shore
- 4.5 Shorelines and beaches
 - 4.5.1 Distinguish between swash and backwash
 - 4.5.2 Explain how swashes and backwashes shape the shoreline
 - 4.5.3 Explain how emergent coasts and submergent coasts differ
 - 4.5.4 Locate emergent and submergent coasts around the United States
 - 4.5.5 Identify two shore features caused by erosion and two shore features caused by deposition
 - 4.5.6 Describe the formation of marine terraces
 - 4.5.7 Classify beaches according to the size of particles
 - 4.5.8 Identify the berm of a beach

- 4.5.9 Diagram the structure of a typical beach
- 4.5.10 Describe the formation of a barrier beach
- 4.5.11 Show the relationship of a spit to a sandbar

5.0 METEOROLOGY

- 5.1 Radiation and heat budget
 - 5.1.1 Describe the effect of incoming solar energy on the development of atmosphere
 - 5.1.2 Explain how the exchange of energy between the earth and its atmosphere keeps the earth's surface warm
 - 5.1.3 Explain how the earth's shape and its rotation determine the distribution of incoming radiation
 - 5.1.4 Describe the "greenhouse effect"
 - 5.1.5 Demonstrate a thermal inversion
- 5.2 Hydrologic cycle
 - 5.2.1 Describe how hydrologic cycle processes of condensation, sublimation, precipitation, and melting are dependent on energy transfer
 - 5.2.2 Explain how the atmosphere participates in the hydrologic cycle through evaporation, transport, and condensation of water
 - 5.2.3 Relate the earth's distance from the sun to the simultaneous existence of water in the gaseous, liquid, and solid state
 - 5.2.4 Clouds
 - 5.2.4.1 Name and describe the conditions necessary for cloud formation
 - 5.2.4.2 Identify hydrologic nuclei and describe their importance to cloud formation
 - 5.2.4.3 Know the symbols for the ten genera of clouds
 - 5.2.4.4 Identify cloud types by their appearance
 - 5.2.4.5 Identify cloud types given their speed of motion and their height
 - 5.2.4.6 Identify appropriate cloud formations necessary to produce the following forms of precipitation: rain, hail, sleet, and snow
 - 5.2.4.7 Identify stratiform and cumuliiform clouds
 - 5.2.4.8 Explain how stratiform and cumuliiform clouds may be formed and the different types of precipitation they produce
 - 5.2.4.9 Distinguish among clouds, fog, and haze
 - 5.2.4.10 Compute the height to which moist air must be lifted for condensation to occur, given the temperature and the vapor pressure
 - 5.2.5 Precipitation
 - 5.2.5.1 Measure the amount of precipitation by making and using a rain gauge
 - 5.2.5.2 Distinguish between hydrometeors and precipitation
 - 5.2.5.3 Discuss the atmospheric conditions necessary for the formation of rain, hail, sleet and snow
- 5.3 Elements of weather
 - 5.3.1 Humidity
 - 5.3.1.1 Describe and give examples of moisture in the atmosphere
 - 5.3.1.2 Identify each of the following and tell how each is determined: relative humidity, absolute humidity, specific humidity, and dew point
 - 5.3.1.3 Determine relative humidity and dew point given the temperature and vapor pressure
 - 5.3.2 Temperature
 - 5.3.2.1 Explain the difference among the various temperature scales and convert from one scale to another
 - 5.3.2.2 Identify each of the following as to operating principle and purpose: liquid-in-glass thermometer, bi-metal thermometer, electrical resistance thermometer, and thermograph
 - 5.3.2.3 Compare construction of three basic liquid-in-glass thermometers and explain their importance in weather analysis
 - 5.3.2.4 Explain how unequal heating of the air and the action of gravity produce unbalanced pressure forces and convection currents
 - 5.3.2.5 Compare the effects of insulation on different materials on the earth
 - 5.3.2.6 Identify and describe wind patterns
 - 5.3.2.7 Identify factors that distinguish the general circulation of the atmosphere
 - 5.3.2.8 Relate Coriolis force to motion of air masses
 - 5.3.2.9 Solve problems using quantitative data and formula for lapse rate
 - 5.3.2.10 Compare convergence and divergence as to direction of flow, movement and relation to precipitation
 - 5.3.2.11 Explain the shape of isotherms on a world map at different seasons
 - 5.3.3 Barometric pressure
 - 5.3.3.1 Read mercurial and aneroid barometers and state the major differences between the two
 - 5.3.3.2 Describe the use of millibars in measuring atmospheric pressure
 - 5.3.3.3 Identify highs and lows on an isobaric map
 - 5.3.3.4 Contrast cyclonic and anticyclonic circulation
 - 5.3.3.5 Diagram the development of a cyclone

- 5.3.3.6 Relate changes in temperature, pressure, and volume to the production of pressure cells
- 5.3.3.7 Correlate unequal heating, gravitation, and rotation with unequal pressure distribution and convection circulation in the atmosphere
- 5.3.3.8 Explain what is meant by adiabatic heating and cooling
- 5.3.3.9 Determine how high a bubble of heated surface air will rise freely, given the observed distribution of temperature in the atmosphere above and the vapor pressure and temperature of the heated bubble
- 5.4 Gas laws
 - 5.4.1 Given the initial pressure, volume, and temperature for an ideal gas, and two of these after the conditions have changed, calculate the unknown
 - 5.4.2 Relate the properties of a gas in terms of temperature, pressure, and volume
- 5.5 Air masses and weather fronts
 - 5.5.1 Define operationally warm and cold fronts in terms of air mass movement
 - 5.5.2 Describe the process by which air masses are created
 - 5.5.3 Know how air masses supply the energy needed for the development of cyclones along a polar front
 - 5.5.4 Identify and use correct symbol for an air mass given its source origin, or state the source region given the symbol
 - 5.5.5 Diagram the formation of the four weather fronts using the symbol for each
 - 5.5.6 Predict the weather at the boundary and passage of a front given the type and motion of the front
 - 5.5.7 Explain how air masses are formed
 - 5.5.8 Describe the life cycle of a frontal cyclone
 - 5.5.9 Describe the tropical weather that a cyclone produces as its potential energy is converted to kinetic energy
 - 5.5.10 Given an isobaric chart, describe weather conditions at a specific location and predict future weather conditions
 - 5.5.11 Interpret a station model
- 5.6 Climate
 - 5.6.1 Identify factors used in classifications of climates
 - 5.6.2 Compare the different methods of classifying climates
 - 5.6.3 Discuss the principle factors contributing the energy and moisture budget for various parts of the earth
 - 5.6.4 Identify the weather factors that determine climate of a local area
 - 5.6.5 Use temperature and precipitation data to locate a place on earth
 - 5.6.6 Demonstrate the relationship among latitude, temperature, and land surfaces
 - 5.6.7 Identify at least five major climatic regions on a world map
 - 5.6.8 Explain existence and location of each major climatic regions on the basis of the hydrologic cycle
 - 5.6.9 Construct graphs illustrating typical temperature and precipitation conditions at various places
- 6.0 EARTH'S PLACE IN SPACE
 - 6.1 Explain what is meant by a universe of galaxies
 - 6.2 Explain how a nebula differs from a galaxy
 - 6.3 Describe the classification system of galaxies
 - 6.4 Describe the Milky Way, including in the description such characteristics as its shape, size, and types of stars and other materials present
 - 6.5 Describe three theories relating to the origin of the universe and point out the strengths and weaknesses of each theory
 - 6.6 List four important characteristics of each planet
 - 6.7 Explain how the Copernican, Kepler, and Ptolemaic systems differ
 - 6.8 Use the formula for the law of gravitation in computing the force of attraction between two bodies
 - 6.9 Explain how gravity and air resistance influence the speed with which an object falls
 - 6.10 Describe the condensing cloud theories
 - 6.11 Describe the nature of cosmic rays and indicate how they may originate
 - 6.12 Describe the surface of the moon and identify craters, maria, and highlands in a picture of the moon
 - 6.13 Identify some constellations and stars, including the Big Dipper, the Little Dipper, Cassiopeia, Orion, Polaris, Deneb, Betelgeuse, and Rigel
 - 6.14 Define Doppler effect
 - 6.15 Explain how the Doppler phenomenon is used by astronomers
 - 6.16 State the difference between centripetal and centrifugal force
 - 6.17 Describe two aspects of Einstein's Theory of Relativity

ADVANCED PHYSICAL SCIENCE

1.0 HISTORICAL DEVELOPMENT

1.1 Men of science

1.1.1 Early contributions

- 1.1.1.1 Describe the influence the ancient Greek philosophers had on the future of science
- 1.1.1.2 Explain how observation without experimentation retarded the advance of progress
- 1.1.1.3 Describe the significant contributions made by scientists such as Galileo, Archimedes, Newton, Copernicus, and Ptolemy

1.1.2 Contributions to science from the Dark Ages to the present

- 1.1.2.1 Trace the formulation of physical laws of science by Galileo, Kepler, and Newton
- 1.1.2.2 Compare Franklin's contributions with Faraday's contributions in the field of electricity
- 1.1.2.3 Trace the development of the knowledge of atomic weights and atomic numbers beginning with contributions made by Mendelev and Dalton
- 1.1.2.4 Describe the experiments that led to the discoveries by Thompson, Rutherford, Chadwick, and Bohr

2.0 SCIENTIFIC METHOD

2.1 The nature of the scientific method

2.1.1 The scientific method in general

- 2.1.1.1 Paraphrase the steps usually associated with the scientific method
- 2.1.1.2 List three ways scientists gather facts
- 2.1.1.3 Demonstrate the scientific method

2.1.2 Terminology of the scientific method

- 2.1.2.1 Discuss the differences between beliefs and facts
- 2.1.2.2 Define the term theory and relate it to a hypothesis
- 2.1.2.3 Define data in terms of results
- 2.1.2.4 Name the five basic terms used in describing the scientific method

2.1.3 Applying the scientific method

- 2.1.3.1 List four situations in a person's life which can be subjected to the scientific method as a method for resolving problems
- 2.1.3.2 Know the attitudes that one must acquire in order to apply the scientific method to everyday life
- 2.1.3.3 Demonstrate how invalid conclusions can be reached in an experiment
- 2.1.3.4 Describe the function of controls in a scientific study

3.0 THE NATURE OF MATTER

3.1 Properties of matter

3.1.1 Physical properties

- 3.1.1.1 Compare weight to mass at different locations
- 3.1.1.2 Define density in terms of mass and volume
- 3.1.1.3 Compare the property of impenetrability to the property of porosity
- 3.1.1.4 Define the term matter and demonstrate the special properties of substances in terms of ductility, hardness, malleability, and brittleness

3.1.2 Chemical properties

- 3.1.2.1 Describe three kinds of chemical bonding
- 3.1.2.2 Explain the functions of the periodic table in terms of chemical bonding
- 3.1.2.3 Classify matter as metal, nonmetals, and metalloids distinguishing the properties of each
- 3.1.2.4 Explain the quantum theory of electrons
- 3.1.2.5 Describe the different uses of the periodic table

3.2 Classes of matter

3.2.1 Elements

- 3.2.1.1 Prove that an element cannot be decomposed by ordinary chemical means
- 3.2.1.2 Name the common elements and write their symbols
- 3.2.1.3 Explain the difference in the isotopes of an element

3.2.2 Compounds

- 3.2.2.1 Describe the decomposition of a compound
- 3.2.2.2 Devise an experiment showing that a chemical reaction is required to form a compound
- 3.2.2.3 Name five of the common compounds that make up the crust of the earth

3.2.3 Mixtures

- 3.2.3.1 Name five kinds of mixtures
- 3.2.3.2 Devise an experiment showing that a mixture can be separated by physical means
- 3.2.3.3 Distinguish between homogeneous and heterogeneous mixtures

3.3 Changes in matter

3.3.1 Nonmolecular changes

- 3.3.1.1 Explain the effect of temperature on the linear dimensions of a solid
- 3.3.1.2 Demonstrate the effects of temperature on a solid
- 3.3.1.3 Demonstrate the effect of temperature on the volume of a liquid
- 3.3.1.4 Apply Boyle's and Charles' laws to the volume of a real gas undergoing changes in temperature and pressure
- 3.3.1.5 Explain the three states of matter in terms of volume

- 3.3.1.6 Relate "mole" volume to gram molecular weight in a gas
- 3.3.1.7 Explain change in state relative to gain or loss of energy
- 3.3.1.8 Explain change in state in terms of the heat value of a substance
- 3.3.2 Molecular changes
 - 3.3.2.1 List four factors that influence chemical change
 - 3.3.2.2 Predict chemical changes using the activity series
 - 3.3.2.3 Explain the process of electron transfer that occurs in molecules
 - 3.3.2.4 Name the four kinds of chemical changes and describe each with a balanced equation
 - 3.3.2.5 Explain how to balance oxidation-reduction equations using oxidation numbers

4.0 EARTH SCIENCE

- 4.1 Atmospheric physics and meteorology
 - 4.1.1 The nature of the atmosphere
 - 4.1.1.1 Name the four basic layers of the atmosphere
 - 4.1.1.2 Describe the properties of each layer of the atmosphere
 - 4.1.1.3 Describe the composition of air
 - 4.1.2 Observations of atmospheric pressure
 - 4.1.2.1 Demonstrate the properties of volume and weight of gases
 - 4.1.2.2 Explain the mathematical concepts of air pressure
 - 4.1.2.3 Describe the early forms of barometers
 - 4.1.2.4 Explain the use of the mercury barometer
 - 4.1.2.5 Explain the use of the aneroid barometer
 - 4.1.2.6 Compare actual atmospheric pressure with standard pressure
 - 4.1.3 Changes in the weather
 - 4.1.3.1 Define the term weather
 - 4.1.3.2 Name the major wind belts of the world
 - 4.1.3.3 Explain the cause of winds
 - 4.1.3.4 Name three different types of windstorms
 - 4.1.3.5 Explain relative humidity
 - 4.1.3.6 Name the three basic cloud types
 - 4.1.3.7 Describe the different air masses of North America
 - 4.1.3.8 Forecast the weather by obtaining local weather information
- 4.2 The nature of the hydrosphere
 - 4.2.1 The properties of water
 - 4.2.1.1 Describe the chemical properties of water
 - 4.2.1.2 Describe the physical properties of water
 - 4.2.1.3 Explain the molecular structure of water
 - 4.2.1.4 Name the kinds of water solutions
 - 4.2.1.5 Demonstrate capillary action
 - 4.2.1.6 Demonstrate the effects of water pressure
 - 4.2.1.7 Demonstrate Archimedes' principle
 - 4.2.1.8 Explain the term specific gravity
 - 4.2.2 Sources of water
 - 4.2.2.1 Describe the water cycle
 - 4.2.2.2 Name the ultimate sources of water
 - 4.2.2.3 Describe the water table
 - 4.2.2.4 Relate the problems of our shrinking water supply
 - 4.2.3 Water pollution and treatment
 - 4.2.3.1 Differentiate between hard water and soft water
 - 4.2.3.2 Name five forms of water pollution
 - 4.2.3.3 Name three kinds of sewage disposal
 - 4.2.3.4 Describe how man has created water pollution
 - 4.2.3.5 Describe water purification procedures
 - 4.2.3.6 Compare the methods of water purification
- 4.3 The lithosphere
 - 4.3.1 General structures of the lithosphere
 - 4.3.1.1 Name the layers of the earth
 - 4.3.1.2 Describe the topography of the United States
 - 4.3.1.3 Explain the differences in temperature at various points and time on the earth's surface
 - 4.3.1.4 Name the three kinds of waves that determine the structure of the earth
 - 4.3.2 Forces that affect the shape of the lands
 - 4.3.2.1 Explain diastrophism
 - 4.3.2.2 Describe the process of weathering
 - 4.3.3 The nature of the crust of the earth
 - 4.3.3.1 Types of rocks
 - 4.3.3.1.1 Explain the formation of sedimentary, igneous, and metamorphic rocks
 - 4.3.3.1.2 Name two examples of each basic type of rock
 - 4.3.3.2 Explain the formation of soil
 - 4.3.3.3 Describe the kinds of soil

- 4.3.4 Minerals in the earth's crust
 - 4.3.4.1 Distinguish between organic and inorganic minerals
 - 4.3.4.2 Name the major classifications of minerals
 - 4.3.4.3 Name the industrial uses of minerals
- 4.3.5 Major sources of fuel today
 - 4.3.5.1 Name the fossil fuels
 - 4.3.5.2 Explain the heat values of the fossil fuels in use today
 - 4.3.5.3 Name the kinds of coal
 - 4.3.5.4 Describe the various uses of petroleum

5.0 SPACE SCIENCE

- 5.1 The nature of the solar system
 - 5.1.1 The relationship of the earth, moon and sun
 - 5.1.1.1 Explain the term "solar system"
 - 5.1.1.2 Know the distance from the earth to the sun and moon
 - 5.1.1.3 Compare the size of the moon, sun, and earth with each other
 - 5.1.1.4 Describe the effects that the moon, sun, and earth have on each other
 - 5.1.1.5 Describe sun spots and their effect on the earth
 - 5.1.1.6 Explain the early beliefs of man as what constituted the center of the solar system
 - 5.1.1.7 Describe the surface of the moon
 - 5.1.1.8 Name the major features of the moon
 - 5.1.1.9 Describe the process of a solar and lunar eclipse
 - 5.1.1.10 Draw charts of the moon's surface and name the major maria
 - 5.1.2 The planets of our solar system
 - 5.1.2.1 Name the planets in order of increasing distance from the sun
 - 5.1.2.2 Describe the relative size and distance of the planets in relation to the earth and the sun
 - 5.1.2.3 Relate a theory of the formation of the solar system
 - 5.1.2.4 Name the distinguishing characteristics of each planet of the solar system
 - 5.1.3 Natural satellites
 - 5.1.3.1 Define the term comet
 - 5.1.3.2 Name five of the famous comets
 - 5.1.3.3 Distinguish among meteoroids, meteors, and meteorites
 - 5.1.4 The stellar universe
 - 5.1.4.1 Define the term light year
 - 5.1.4.2 Define the term stellar parallax and describe how it is used to find distance
 - 5.1.4.3 Compare the relative sizes of stars to our sun
 - 5.1.4.4 Describe a variable star
 - 5.1.4.5 Name in what part of the Milky Way the earth is located
 - 5.1.4.6 Discuss how the speed of light affects our reception of starlight
 - 5.1.4.7 Describe why dead stars are so dense
 - 5.1.4.8 Describe the life cycle of a star
 - 5.1.4.9 Compare the brightness and color of stars with their temperatures
 - 5.1.4.10 Describe the composition of a nebula
 - 5.1.4.11 Describe the various kinds of galaxies
 - 5.1.4.12 Describe the various constellations that occur in the sky at night
- 5.2 Tools of astronomy
 - 5.2.1 Early exploration
 - 5.2.1.1 Name the instruments used in early times in the study of astronomy
 - 5.2.1.2 Describe the different types of telescopes and explain how they work
 - 5.2.1.3 Explain how the spectrum of color from starlight is studied with a spectroscope
 - 5.2.1.4 Describe a radiotelescope and tell how it is used to study the universe
- 5.3 Location and measurement of time
 - 5.3.1 Longitude and latitude
 - 5.3.1.1 Define the terms longitude and latitude
 - 5.3.1.2 Draw locations of major cities in terms of longitudes and latitudes
 - 5.3.2 The effect of the earth's movement
 - 5.3.2.1 Define the terms rotation and revolution
 - 5.3.2.2 Describe the characteristics of the earth's orbit
 - 5.3.2.3 Explain what is meant by a solar day
 - 5.3.2.4 Name the time zones of the United States and give the time in other time zones
 - 5.3.2.5 Explain the purpose of daylight savings time
 - 5.3.2.6 Explain the use of the International Date Line

6.0 ENERGY AND FORCES

- 6.1 Kinetic energy
 - 6.1.1 The nature of kinetic energy
 - 6.1.1.1 Define the term kinetic energy

- 6.1.1.2 Describe the units of measurement in kinetic energy
- 6.2 Potential energy
 - 6.2.1 The nature of potential energy
 - 6.2.1.1 Define the term potential energy
 - 6.2.1.2 Compare kinetic and potential energy
 - 6.2.1.3 Demonstrate the conversion of potential energy to kinetic energy
- 6.3 Forms of energy
 - 6.3.1 Heat energy
 - 6.3.1.1 Name examples of heat energy
 - 6.3.1.2 Describe the relationship of friction to heat
 - 6.3.2 Chemical energy
 - 6.3.2.1 Name examples of chemical energy
 - 6.3.2.2 Relate chemical change in terms of chemical energy
 - 6.3.3 Mechanical energy
 - 6.3.3.1 Name examples of mechanical energy
 - 6.3.3.2 Describe a machine in terms of mechanical energy
 - 6.3.4 Sound energy
 - 6.3.4.1 Name examples of sound energy
 - 6.3.4.2 Define sound in terms of energy
 - 6.3.5 Nuclear energy
 - 6.3.5.1 Name examples of nuclear energy
 - 6.3.6 Light energy
 - 6.3.6.1 Name examples of light energy
- 6.4 Conversions of energy from one form to another
 - 6.4.1 Describe how the forms of energy may be converted from one form to another
- 6.5 Introduction to forces
 - 6.5.1 Forces in general
 - 6.5.1.1 Explain what is meant by force
 - 6.5.1.2 Define inertia, weight, and mass in units of force
 - 6.5.1.3 Describe the force vectors of velocity and acceleration
 - 6.5.2 Newton's laws of motion
 - 6.5.2.1 Explain Newton's three laws of motion
 - 6.5.2.2 Demonstrate Newton's three laws of motion
 - 6.5.2.3 Describe the uses of the laws of motion
 - 6.5.3 Energy changes caused by force
 - 6.5.3.1 Define the scientific meaning of work
 - 6.5.3.2 Compare work and energy
 - 6.5.3.3 Define the term power
 - 6.5.3.4 Define and explain the gravitational factor

7.0 SIMPLE MACHINES

- 7.1 The nature of a machine
 - 7.1.1 Definition of simple machines
 - 7.1.1.1 Describe a simple machine
 - 7.1.1.2 Distinguish between simple and compound machines
 - 7.1.2 Kinds of simple machines
 - 7.1.2.1 Explain the use of the lever
 - 7.1.2.2 Name the parts of a lever
 - 7.1.2.3 Name the three classes of levers and the position of the parts as related to classification
 - 7.1.2.4 Explain the purpose of a single pulley
 - 7.1.2.5 Explain the advantage of using a block and tackle
 - 7.1.2.6 Determine the mechanical advantage in an inclined plane
 - 7.1.2.7 Relate thickness of a wedge with mechanical advantage
 - 7.1.2.8 Describe how a screw is actually made from an inclined plane
 - 7.1.2.9 Explain the part friction plays in the efficiency of the screw
 - 7.1.2.10 Determine the mechanical advantage of the wheel and axle
 - 7.1.3 Mechanical advantage
 - 7.1.3.1 Determine the mechanical advantage of any simple machine using weight and effort
 - 7.1.4 Law of machines
 - 7.1.4.1 Define the term work
 - 7.1.4.2 State and explain the law of machines
 - 7.1.4.3 Define the term efficiency
 - 7.1.4.4 Determine the efficiency of simple machines

8.0 WAVE MOTION

- 8.1 Properties of waves
 - 8.1.1 Frequency
 - 8.1.1.1 Define the term frequency
 - 8.1.1.2 Determine the frequency of a wave
 - 8.1.2 Period
 - 8.1.2.1 Describe the period of a wave
 - 8.1.2.2 Determine the period of a wave

- 8.1.3 Wavelength
 - 8.1.3.1 Define the term wavelength
 - 8.1.3.2 Determine wavelength of a sine wave
- 8.1.4 Relationship of frequency, wavelength, and velocity
 - 8.1.4.1 Explain the relationship among frequency, wavelength and velocity of waves
 - 8.1.4.2 Solve problems using frequency, wavelength, and velocity of waves
- 8.2 Longitudinal Waves
 - 8.2.1 Characteristics of longitudinal waves
 - 8.2.1.1 Define the term longitudinal waves
 - 8.2.1.2 Name the parts of a longitudinal wave
 - 8.2.1.3 Explain how longitudinal waves are formed
 - 8.2.1.4 Name examples of longitudinal waves
- 8.3 Transverse Waves
 - 8.3.1 Characteristics of transverse waves
 - 8.3.1.1 Define the term transverse wave
 - 8.3.1.2 Name the parts of a transverse wave
 - 8.3.1.3 Distinguish between transverse and longitudinal waves
- 8.4 Sound
 - 8.4.1 Characteristics of sound
 - 8.4.1.1 Explain how sound waves travel
 - 8.4.1.2 Explain sound waves in terms of source, disturbance and medium
 - 8.4.2 Definition of sound
 - 8.4.2.1 Distinguish between the physical and physiological definition of sound
 - 8.4.2.2 Describe the process of hearing
 - 8.4.3 Source of sound
 - 8.4.3.1 Describe the source of all sounds
 - 8.4.3.2 Describe how the human being makes a vocal sound
 - 8.4.4 The speed of sound
 - 8.4.4.1 Compare the speed of sound with the speed of light
 - 8.4.4.2 Compare the speed of sound in different media
 - 8.4.4.3 Give examples of different types of sounds
 - 8.4.5 Reflection of sound
 - 8.4.5.1 Explain the mechanism of echoes
 - 8.4.5.2 Explain how echoes are used to determine distance
 - 8.4.6 Music
 - 8.4.6.1 Distinguish between music and noise
 - 8.4.6.2 Name the three physiological properties of music and their three physical dependents
 - 8.4.7 Sound through the human ear
 - 8.4.7.1 Determine the frequency range that the human ear can interpret
 - 8.4.7.2 Trace sound through the ear
 - 8.4.8 Doppler effect
 - 8.4.8.1 Define the term "Doppler effect"
 - 8.4.8.2 Name common examples of "Doppler effect"
 - 8.4.9 Interference of sound waves
 - 8.4.9.1 Describe constructive and destructive interference in sound waves
 - 8.4.9.2 Define the term beats
 - 8.4.10 Resonance
 - 8.4.10.1 Define the term resonance
 - 8.4.10.2 Explain the principle of resonance
 - 8.4.11 Production of music
 - 8.4.11.1 Name and explain the three laws of vibrating strings
 - 8.4.11.2 Explain how harmonics affects the quality of sound
- 8.5 Light
 - 8.5.1 Speed of light
 - 8.5.1.1 Name the men that made major contributions in determining the speed of light
 - 8.5.1.2 Explain how the speed of light was determined
 - 8.5.2 Wave theory versus particle theory
 - 8.5.2.1 Name the men that made major contributions in trying to prove that light is a wave or a particle and explain how they did prove their theories
 - 8.5.2.2 Describe the modern theory of light
 - 8.5.2.3 Explain how polarization of light shows evidence of the wave theory
 - 8.5.3 Photoelectric effect
 - 8.5.3.1 Name the person who described the photoelectric effect
 - 8.5.3.2 Describe briefly what happens in the photoelectric effect
 - 8.5.4 Interference of light
 - 8.5.4.1 Explain interference in terms of the modern theory of light
 - 8.5.5 Reflection of light
 - 8.5.5.1 Explain the law of reflection
 - 8.5.5.2 Distinguish between a real and a virtual image
 - 8.5.5.3 Describe the cases of the image distance and location formed by plane mirrors, convex mirrors, and concave mirrors
 - 8.5.6 Refraction of light
 - 8.5.6.1 Explain refraction of light

- 8.5.6.2 Name the kinds of lenses and describe the images they form
- 8.5.7 Measurement of light
 - 8.5.7.1 Distinguish between light intensity and illumination
 - 8.5.7.2 Name the units to measure light energy
- 8.5.8 Color
 - 8.5.8.1 Describe the spectrum of light
 - 8.5.8.2 Describe the uses of spectral analysis
 - 8.5.8.3 Explain the process of seeing color
- 8.6 Electricity
 - 8.6.1 Static electricity
 - 8.6.1.1 Describe the basic electrical structure of matter
 - 8.6.1.2 Explain how static charges are produced
 - 8.6.1.3 Explain the law of electrostatic charges
 - 8.6.1.4 Explain charging by conduction and induction by using the electroscope
 - 8.6.1.5 List some of the hazards of static electricity
 - 8.6.1.6 Describe the formation of lightning
 - 8.6.2 Current electricity
 - 8.6.2.1 Define the terms coulomb, ampere, volt, and ohm
 - 8.6.2.2 Explain the different instruments used to measure electrical properties
 - 8.6.2.3 Distinguish between conductors and insulators and give examples
 - 8.6.2.4 Determine the difference of flow of electricity through parallel and series circuits
 - 8.6.2.5 Describe series and parallel circuits
 - 8.6.3 Chemical action and electricity
 - 8.6.3.1 Describe the early contributions of using chemical action as a source of electricity
 - 8.6.3.2 Explain how a simple dry cell works
 - 8.6.3.3 Explain the process of electrolysis
 - 8.6.3.4 Describe the process of electroplating

9.0 ELECTRONICS AND COMMUNICATION

- 9.1 Means of communication
 - 9.1.1 Communication by wire
 - 9.1.1.1 Describe the historical aspects of communication by electrical devices
 - 9.1.1.2 Distinguish between wire and wireless communication
 - 9.1.1.3 Explain the principle of the telegraph
 - 9.1.1.4 Draw the circuit between a receiver and transmitter in the telephone
 - 9.1.1.5 Explain the uses of the co-axial cable
 - 9.1.2 Wireless communication
 - 9.1.2.1 Describe the principle components of radio transmission
 - 9.1.2.2 Explain the uses of microwaves
 - 9.1.2.3 Name four uses of radar
 - 9.1.2.4 Compare the advantages and disadvantages of wireless to wire communications
- 9.2 Controlling the flow of electrons
 - 9.2.1 Semiconductors
 - 9.2.1.1 Name the parts of the vacuum tube
 - 9.2.1.2 Explain the "Edison effect"
 - 9.2.1.3 Describe the P and N type of semiconductors
 - 9.2.1.4 Describe the uses of solar cells
 - 9.2.1.5 Explain the principle of the transistor
 - 9.2.1.6 Compare the vacuum tube with the transistor

10.0 ELECTRONIC COMPUTERS AND AUTOMATION

- 10.1 Types of computers
 - 10.1.1 Analog computers
 - 10.1.1.1 Name three kinds of analog computers
 - 10.1.1.2 Explain the read-outs produced by analog computers
 - 10.1.1.3 Demonstrate the principle of the abaci
 - 10.1.2 Digital computers
 - 10.1.2.1 Explain the principle of the adding machine
 - 10.1.2.2 Name three kinds of digital computers
 - 10.1.2.3 Explain the principle of a digital computer
 - 10.1.2.4 Explain binary number, bases of number systems, and conversions of binary and decimal numbers
 - 10.1.3 Uses of computers
 - 10.1.3.1 Name the three classes of computer uses
 - 10.1.3.2 Explain the use of the punched card
- 10.2 Automatic devices
 - 10.2.1 Describe three kinds of automatic devices used in each the home, transportation, and industry

11.0 NUCLEAR ENERGY

11.1 The atom

11.1.1 Atomic structure

- 11.1.1.1 Relate the historical aspects of discoveries in atomic structure
- 11.1.1.2 Diagram atomic models describing atomic structure
- 11.1.1.3 Describe the electron
- 11.1.1.4 Explain the charge, size, and mass of the electron
- 11.1.1.5 Describe the proton
- 11.1.1.6 Describe the methods used by physicists to measure the proton
- 11.1.1.7 Describe the neutron
- 11.1.1.8 Explain nuclear mass defect
- 11.1.1.9 Distinguish between the concepts of atomic number and mass number
- 11.1.1.10 Describe alpha particles, beta particles, and gamma rays in terms of their origins and effects

11.1.2 Changes within the atom

- 11.1.2.1 Describe the nature, types, general properties and detection of radioactivity
- 11.1.2.2 Name and describe the types of detection instruments used in radioactivity determination
- 11.1.2.3 Explain the basic types of nuclear reactions

11.2 Uses of nuclear energy

11.2.1 Fuels of nuclear energy

- 11.2.1.1 Define the term isotope
- 11.2.1.2 Distinguish between isotopes of Uranium 238 and 235
- 11.2.1.3 Compare uranium with cobalt and other sources of nuclear energy in terms of heat

11.2.2 Nuclear electric power

- 11.2.2.1 Name three kinds of nuclear reactors
- 11.2.2.2 Draw a nuclear reactor in simplified form and explain the function of each part

CHEMISTRY

1.0 MASS, ENERGY AND ATOMIC STRUCTURE

- 1.1 Matter - its classification and phases
 - 1.1.1 Define matter and mass
 - 1.1.2 Identify the general classes of matter
 - 1.1.3 Identify physical and chemical properties of matter
 - 1.1.4 Describe the three major phases of matter
 - 1.1.5 Measure some physical properties of matter
- 1.2 Energy
 - 1.2.1 Describe the major forms of energy
 - 1.2.2 State sources and transformation of energy
 - 1.2.3 State the law of conservation of energy and its application
 - 1.2.4 Define temperature and heat
 - 1.2.5 Use three different temperature scales
- 1.3 Structure of the atom
 - 1.3.1 Describe the major particles of the atom and illustrate a model of the atom
 - 1.3.2 Define atomic number, atomic mass, atomic weight, and atomic mass number
 - 1.3.3 Give electron configuration for the first 20 elements and some of the elements with exceptional structures
 - 1.3.4 Identify the valence electrons of an atom and their importance in determining chemical properties of elements
 - 1.3.5 State the periodic law; trace its historic development and the use of the periodic table
- 1.4 Families of elements
 - 1.4.1 Describe chemical properties common to each family
 - 1.4.2 Identify some of the elements by means of various tests
 - 1.4.3 Describe variations of chemical properties within each family
 - 1.4.4 List and describe common compounds of representative elements of each family

2.0 BEHAVIOR OF GASES; KINETICS

- 2.1 The gas laws
 - 2.1.1 Use Boyle's law, Charles' law, and the Combined gas law to solve stated problems
 - 2.1.2 Discuss the difference between real and ideal gases and the applicability of the gas laws
 - 2.1.3 Use Avogadro's hypothesis in the solution of problems
- 2.2 The kinetic theory
 - 2.2.1 Use the kinetic theory to explain physical properties of the three phases of matter and phase changes
 - 2.2.2 Use the kinetic theory to explain diffusion
 - 2.2.3 Explain dynamic equilibrium using the kinetic theory

3.0 CHEMICAL COMPOSITION AND REACTIONS

- 3.1 Symbols, formulas, and radicals
 - 3.1.1 Give correct symbols and radicals for atoms and ions
 - 3.1.2 Use the oxidation number concept to write formulas
 - 3.1.3 Name compounds from given formulas
 - 3.1.4 Determine the percentage composition of several compounds
 - 3.1.5 Determine the formula of a compound from its percentage composition
- 3.2 Chemical reactions
 - 3.2.1 Identify the types of chemical reactions
 - 3.2.2 Write and balance equations describing chemical reactions (including oxidation and reduction reactions)
 - 3.2.3 Solve problems of mass and volume relations in chemical reactions
 - 3.2.4 Use the mole concept to solve problems
 - 3.2.5 Identify factors that influence rate of chemical reactions
 - 3.2.6 Explain chemical equilibrium and apply LeChatelier's principle
- 3.3 Acids, bases, and salts
 - 3.3.1 Trace the historic development and theories of acids
 - 3.3.2 Classify inorganic compounds as acids, bases, and salts
 - 3.3.3 Use indicators to determine pH of a solution
 - 3.3.4 List some important industrial and household uses of acids, bases, and salts
 - 3.3.5 Demonstrate the ways by which chemical reactions go to completion

4.0 SOLUTIONS AND SUSPENSIONS

- 4.1 The solution process
 - 4.1.1 Identify factors that influence rate of solution
 - 4.1.2 Determine solubility of some solutes
- 4.2 Concentration of solutions
 - 4.2.1 Solve problems dealing with molarity, normality and other concentration descriptions
 - 4.2.2 Prepare solutions of stated concentration
 - 4.2.3 Determine the concentration of a solution by titration
 - 4.2.4 Recover the solute and solvent from a combination by distillation

- 4.3 Ionization and dissociation
 - 4.3.1 State the modern theory of ionization
 - 4.3.2 Distinguish between electrolytes and non-electrolytes
 - 4.3.3 Perform calculations involving pH
 - 4.3.4 Solve problems involving ionization equilibrium
- 4.4 Suspensions
 - 4.4.1 Describe the difference in suspensions and other solutions
 - 4.4.2 Describe the various types of suspensions
 - 4.4.3 Separate a suspension by filtration

5.0 CARBON CHEMISTRY

- 5.1 Forms of carbon
 - 5.1.1 Describe the forms of carbon
 - 5.1.2 Illustrate by using simple demonstrations the properties of the different forms of carbon
 - 5.1.3 Diagram the electron configuration of carbon
 - 5.1.4 Use simple apparatus to show how the amorphous form of carbon may be produced
- 5.2 Oxides of carbon
 - 5.2.1 State the importance of the oxides of carbon
 - 5.2.2 Show how the oxides can be oxidized into useful compounds
 - 5.2.3 Demonstrate by using simple experiments that one oxide may be dangerous and another one useful
 - 5.2.4 Illustrate the molecular structure of the oxides of carbon
 - 5.2.5 Illustrate resonance using carbon dioxide electronic structure
- 5.3 Hydrocarbons and hydrocarbon substitution products
 - 5.3.1 Demonstrate how carbon atoms link together with covalent bonds
 - 5.3.2 Show how different structural arrangements represent a separate compound but have the same molecular formula
 - 5.3.3 Illustrate how an organic compound differs from the inorganic compound
 - 5.3.4 Give examples of how hydrocarbons are classified
 - 5.3.5 Prepare an alkane by fractional distillation
 - 5.3.6 Use a simple procedure to make soap
 - 5.3.7 Explain how alkyl halogenides are prepared
 - 5.3.8 Show how alcohols are prepared by substitution
 - 5.3.9 Compare structural formulas for members of the different series of hydrocarbons
 - 5.3.10 Explain octane ratings
- 5.4 Natural organic compounds
 - 5.4.1 Explain the importance of the natural occurring organic compounds such as carbohydrates, fats, and proteins
 - 5.4.2 Show how hydrolysis may be used to produce alcohol and glycerol
 - 5.4.3 Demonstrate the properties of monosaccharides and polysaccharides
 - 5.4.4 Explain the chemical nature of proteins
 - 5.4.5 Compare sugars and starches
 - 5.4.6 Test foods for the presence of fats, sugars, starches, and proteins
 - 5.4.7 Compare properties of different kinds of plastics
 - 5.4.8 Describe the compounding of rubber, and compare natural and synthetic rubber by composition, properties, and uses
 - 5.4.9 Make paper and identify textile fibers

6.0 NUCLEAR CHEMISTRY

- 6.1 Types of nuclear reactions
 - 6.1.1 Define and illustrate nuclear fusion, fission and transmutation
- 6.2 Nuclear energy
 - 6.2.1 Identify the three basic types of radiation and list their properties and effects
 - 6.2.2 Define nuclear mass defect, binding energy and use these to explain conversion of matter to energy in nuclear reactions

PHYSICS

1.0 MEASUREMENT

- 1.1 System of measurement
 - 1.1.1 Discuss why the SI system of measurements should be used internationally today
 - 1.1.2 Discuss the historical development of the system of measurements using the basic units of mass, length and time
 - 1.1.3 Know the international standard for the kilogram, meter and the second
 - 1.1.4 Know the numerical relationships between the metric and English units of mass, length, time and volume
- 1.2 Measuring devices
 - 1.2.1 Determine length, mass and time using a meterstick, balance and clock
 - 1.2.2 Read a vernier scale
- 1.3 Write numbers in scientific notation form
- 1.4 Perform operations with significant figures using measurements obtained in the laboratory
- 1.5 Exhibits skill in the use of the slide rule for problem solving
- 1.6 Demonstrate an understanding of how the slide rule works in multiplication and division: the addition and subtraction of logarithms

2.0 MECHANICS

- 2.1 Vectors
 - 2.1.1 Identify the characteristics of vector and scalar quantities
 - 2.1.2 List some scalar quantities
 - 2.1.3 List some vector quantities
 - 2.1.4 Add two vector quantities graphically
 - 2.1.5 Add two vectors at right angles using the trigonometric functions of a right triangle
 - 2.1.6 Add two vectors not at right angles using the law of sines and law of cosines
- 2.2 Uniformly accelerated motion
 - 2.2.1 Contrast between Galileo's and Aristotle's views of motion
 - 2.2.2 Discuss Galileo's problems with the church and society
 - 2.2.3 Define the terms displacement, speed, velocity and acceleration
 - 2.2.4 Draw graphs to show the relationships between displacement, velocity, and acceleration with time
 - 2.2.5 Distinguish between uniform velocity and uniform acceleration
 - 2.2.6 Determine the distance, velocity or time when given two of these quantities
 - 2.2.7 Solve for distance, time, velocity and acceleration using the series of equations for uniformly accelerated motion
- 2.3 Newton's laws of motion
 - 2.3.1 State Newton's three laws of motion
 - 2.3.2 Define the terms inertia and inertial mass
 - 2.3.3 State examples of the application of each of Newton's laws
 - 2.3.4 Define the term force
 - 2.3.5 Use quantitative relationship of Newton's second law to relate force, inertial mass and acceleration
 - 2.3.6 Explain why bodies of different masses, in the absence of air resistance, fall at the same velocity
 - 2.3.7 Solve additional mathematical applications of Newton's laws of motion
 - 2.3.8 Define the terms friction and coefficient of friction
 - 2.3.9 Determine the coefficient of friction
 - 2.3.10 Use the mathematical relationship for the coefficient of friction to solve problems
- 2.4 Gravity and weight
 - 2.4.1 State Newton's law of gravity
 - 2.4.2 Recognize the nature of the inverse square law found in Newton's law of gravity
 - 2.4.3 Differentiate between gravitational force (weight) and gravitational mass
 - 2.4.4 Determine the magnitude and direction of the gravitational force
 - 2.4.5 Calculate the force of gravity between two masses
 - 2.4.6 Determine the weight of an object above the surface of the earth and on other planets
- 2.5 Curvilinear motion
 - 2.5.1 Explain how a satellite can remain in orbit around the earth without falling into or flying away from it
 - 2.5.2 Define the term centripetal acceleration
 - 2.5.3 Tell why in the absence of friction a rifle bullet when fired horizontally will hit the ground at the same time as one dropped vertically
 - 2.5.4 Define the terms angular distance, angular velocity, angular acceleration, and centripetal acceleration
 - 2.5.5 Solve problems using the equations for uniformity accelerated motion
- 2.6 Energy and work
 - 2.6.1 Define the terms energy, work, and power
 - 2.6.2 Discuss the law of conservation of energy
 - 2.6.3 Give an example of how energy is conserved
 - 2.6.4 Explain in terms of energy what happens to a body as it is projected upward and returns to its original position
 - 2.6.5 Differentiate between a conservative and non-conservative force
 - 2.6.6 Solve mathematical equations involving work, power, and energy

- 2.6.7 List the six simple machines and tell how to determine the mechanical advantage and efficiency of each
- 2.7 Momentum and impulse
 - 2.7.1 Define the terms momentum and impulse
 - 2.7.2 Discuss the law of conservation of momentum
 - 2.7.3 Give examples of the law of conservation of momentum
 - 2.7.4 Explain why a rifle recoils when a bullet is fired
 - 2.7.5 Define angular momentum and give an example of the conservation of angular momentum
 - 2.7.6 Solve simple problems using the conservation of linear momentum
 - 2.7.7 Differentiate between an elastic and inelastic collision
 - 2.7.8 Solve problems demonstrating that impulse produces a change in momentum
- 2.8 Fluids: principles
 - 2.8.1 Define the terms density and pressure
 - 2.8.2 Discuss the pressure due to a column of fluid
 - 2.8.3 State and give a descriptive discussion of: Archimedes', Pascal's, and Bernoulli's principles
 - 2.8.4 Explain how a submarine can both float and sink
 - 2.8.5 Explain how a baseball curves
 - 2.8.6 Explain how a hydraulic lift at a service station works
 - 2.8.7 Explain how a barometer works
 - 2.8.8 Solve mathematical problems using Archimedes', Pascal's, and Bernoulli's principles

3.0 HEAT

- 3.1 Describe the difference between heat and temperature, citing specific examples using the proper units
- 3.2 Describe what is meant by the term heat engine
- 3.3 Convert Fahrenheit temperature to Celsius temperature and Celsius temperature to Kelvin temperature using the appropriate mathematical formulas
- 3.4 Discuss the processes of heat transfer by conduction, convection, and radiation; give specific examples of each
- 3.5 Give an explanation of the factors that are important in insulating a house, such as: type of insulation, thickness, color of roof, storm windows, caulking, etc.
- 3.6 Describe the various forms in which energy occurs in an automobile engine and identify where and when the conversion of chemical to heat to mechanical energy takes place
- 3.7 Describe how the color and texture of an object can effect its temperature and rate of gaining or losing heat energy
- 3.8 Describe qualitatively why bridges ice over before roadways
- 3.9 Relate quantitatively the change in heat with respect to mass, specific heat and temperature change; show how to use this relationship to measure various quantities
- 3.10 Determine the change in length of a substance when the length, coefficient of linear expansion, and temperature change are known
- 3.11 Explain in a descriptive manner why energy must be added to change a solid to a liquid or a liquid to a gas
- 3.12 Discuss ways in which the freezing and boiling points of materials can be changed (changes in impurities, pressure, etc.)
- 3.13 Define the terms heat of fusion and vaporization and mathematically solve calorimetry problems
- 3.14 Discuss the principle of operation of the refrigerator
- 3.15 Discuss the relation between heat and mechanical energy and define the mechanical equivalent of heat
- 3.16 Solve problems using thermodynamics (heat engines, etc.)
- 3.17 List the basic assumptions of the kinetic theory of matter and describe the following characteristics of matter using the kinetic theory: pressure, heat conduction, expansion upon heating, and change of state
- 3.18 Use Boyle's and Charles' laws quantitatively to relate the parameters of p , v , n , and T
- 3.19 Discuss specific properties of solids, liquids, and gases
- 3.20 Contrast the difference in temperature and heat using the microscopic kinetic theory
- 3.21 Describe, qualitatively, the factors that affect the operation (or efficiency) of heat engines
- 3.22 List the efficiency of some thermal engines
- 3.23 Discuss the statement "If all energy (or nearly all) ends up as heat then why don't we burn up"

4.0 WAVES AND SOUND

- 4.1 Vibrations and waves
 - 4.1.1 List the characteristics and distinguish the differences in a single pulse versus a periodic wave
 - 4.1.2 Identify the following characteristics of a periodic wave: displacement, amplitude, velocity, period, frequency and wavelength
 - 4.1.3 Identify two types of waves, longitudinal and traverse; give an example of each type; and use a slinky to demonstrate each type

- 4.1.4 Develop the relationship between v , λ , and f for a wave
- 4.1.5 Use the following formulas to find T when given f , f when given T , v when given λ and f ; rearrange the last formula, $v = \lambda f$, and solve for any other of the variables when given the other two
- 4.1.6 Display graphically, variations of the wavelength, displacement, frequency and amplitude for transverse waves
- 4.1.7 Define the term and give an example of the following wave properties: reflection, refraction, diffraction, interference and super position
- 4.1.8 Relate the speed of propagation of a wave to the characteristics of the medium through which it travels
- 4.1.9 Add two periodic waves geometrically and observe the effects of super position
- 4.2 Sound waves
 - 4.2.1 Discuss how sound waves are produced and how they are transmitted through different media
 - 4.2.2 Contrast the subjective properties of pitch and loudness with frequency and amplitude
 - 4.2.3 Relate the velocity of sound propagation to the density and temperature of the medium
 - 4.2.4 Demonstrate the principle of super position by the production of beats
 - 4.2.5 Demonstrate forces, vibrations and natural resonance of bodies
 - 4.2.6 Illustrate graphically and by experiment the production of standing waves on a string as an example of super position of waves
 - 4.2.7 Calculate the natural frequency of vibration of strings and organ pipes
 - 4.2.8 Define the term and illustrate the principle of the Doppler effect
 - 4.2.9 Solve problems using the algebraic relations of velocity addition in the Doppler effect
 - 4.2.10 Define the term the decibel scale of intensity measurement and measure the sound levels of common noises
 - 4.2.11 Discuss the effects of noise in our environment to social and physiological problems
 - 4.2.12 Explain the cause and effect of the sonic boom
- 4.3 Musical sounds
 - 4.3.1 Define the term musical harmonics and express the frequency relationship between fundamental and harmonic tones
 - 4.3.2 Explain why musical instruments playing the same note have quite different tonal qualities in terms of energy content in various harmonics
 - 4.3.3 Draw a schematic of the human ear, listing the three basic cavities and detail the role of the ossicles and inner ear
 - 4.3.4 Indicate the frequency response of the normal and abnormal ear and the frequency range of the normal male and female voice

5.0 LIGHT

- 5.1 The wave and quantum nature of light
 - 5.1.1 State the difference between Newton's corpuscular and Huygen's wave theory of light
 - 5.1.2 State how each theory accounted for the known properties of light and state the shortcomings of each theory
 - 5.1.3 Explain how Galileo, Roemer, and Michelson determined the speed of light
 - 5.1.4 Explain, using the ultraviolet catastrophe, why Planck found it necessary to assume that energy was emitted and absorbed in discrete quantities
 - 5.1.5 Explain the results of photoelectric emission using Planck's quantum theory
 - 5.1.6 Exhibit an understanding of the relationship between the energy and frequency of a photon
 - 5.1.7 Exhibit an understanding of and ability to use the photoelectric equation, $E = hf - W$
- 5.2 Light emission and color
 - 5.2.1 Explain how the Bohr model of the atom overcame the Rutherford model of the atom's problem of not radiating energy even though the electrons were undergoing acceleration
 - 5.2.2 Explain, using the Bohr model, how an atom emits light
 - 5.2.3 Define the terms incandescence, fluorescence and phosphorescence
 - 5.2.4 Differentiate among continuous, bright line and absorptions spectra and describe the mechanism or physical process for each
 - 5.2.5 Explain the basic principles of how a laser works and give some applications of the laser
 - 5.2.6 Demonstrate a knowledge of the term complementary colors
 - 5.2.7 Determine the color of the combination of several (additive) colors
 - 5.2.8 Discuss the quantum theory of the atom and describe in terms of atomic and molecular energy levels light emission, incandescence, fluorescence, phosphorescence, and the laser
- 5.3 The behavior of light
 - 5.3.1 Define reflection, refraction, scattering, diffraction, interference, and polarization of light
 - 5.3.2 Distinguish between real and virtual images
 - 5.3.3 Draw ray diagrams of plane and curved surfaces

- 5.3.4 Explain the green house effect, atmospheric refraction (looming and mirage), how a rainbow is formed, blue sky, red sun at sunrise and sunset and the ring around the moon
- 5.3.5 Explain why dispersion occurs in a prism
- 5.3.6 Define the index of refraction and use this definition to determine the index of refraction or speed of light in a material, given one of these values
- 5.3.7 Use the mirror equation: $1/f = 1/s + 1/s_i$
- 5.3.8 State Snell's law, $n_1 \sin i = n_2 \sin r$, and use this equation in calculations
- 5.4 Lenses and optical instruments
 - 5.4.1 Distinguish between diverging and converging lenses
 - 5.4.2 Draw ray diagrams and locate the image in lenses
 - 5.4.3 Use the lens equation: $1/f = 1/s_o + 1/s_i$
 - 5.4.4 Determine image size using equation $h_o/h_i = s_o/s_i$
 - 5.4.5 Explain the optics of the eye
 - 5.4.6 Draw a ray diagram and explain how the reflector and refractor telescope work
 - 5.4.7 Draw a ray diagram and explain how the microscope works

6.0 ELECTRICITY AND MAGNETISM

- 6.1 Static electricity
 - 6.1.1 Identify the condition of charge
 - 6.1.2 Recognize the uniqueness of charge
 - 6.1.3 Recognize the processes of a body acquiring a net charge; the gaining or losing of electrons and charging by induction
 - 6.1.4 Exhibit an understanding of the magnitude of electrical forces
 - 6.1.5 Exhibit an understanding of the inverse square law as it applies to electrical forces
 - 6.1.6 Exhibit an understanding of the properties of materials that determine their classification as conductors, semi-conductors, or insulators
 - 6.1.7 Demonstrate an understanding of an electrical field
 - 6.1.8 Demonstrate an understanding of electrical potential
 - 6.1.9 Solve problems using Coulomb's law, $F = k q_1 q_2 / r^2$; $E = F/q$; and $V = w/q$
- 6.2 Current electricity
 - 6.2.1 Define the term electrical current
 - 6.2.2 Identify what causes electrical charges to flow
 - 6.2.3 Define the term electromotive force
 - 6.2.4 Discuss the relationship between current, voltage and resistance (Ohm's Law)
 - 6.2.5 Contrast series and parallel wiring circuits and give practical examples of each
 - 6.2.6 Solve for the current and voltage of series and parallel circuits
 - 6.2.7 Differentiate between direct and alternating current
 - 6.2.8 Explain the source of electrons that cause the filament of a light bulb to light up
 - 6.2.9 Explain why the use of additional appliances on a circuit causes it to overload, i.e., causes a fuse to blow or circuit breaker to trip
 - 6.2.10 Describe the mechanism for making batteries of different voltages
- 6.3 Effect of electrical currents
 - 6.3.1 Describe the power dissipated in a circuit in terms of V, I, and R
 - 6.3.2 Discuss Joule's law of heating
 - 6.3.3 Discuss Faraday's law of electrolysis
- 6.4 Magnetism and electromagnetic induction
 - 6.4.1 Describe the nature of magnetism
 - 6.4.2 List ways that a magnetic field may be produced
 - 6.4.3 Explain how an iron bar can be magnetized or demagnetized
 - 6.4.4 Explain why all iron is not magnetic
 - 6.4.5 Describe the conditions necessary for a charged particle to experience a force in a magnetic field
 - 6.4.6 Define the terms ferromagnetism, paramagnetism and diamagnetism and discuss the origin of permanently magnetized materials
 - 6.4.7 Describe Faraday's law of electromagnetic induction
 - 6.4.8 Discuss the operating principles of a transformer
 - 6.4.9 Discuss the operating principles of meters, motors, and generators
 - 6.4.10 Develop the concepts of A.C. circuit theory and illustrate with examples of A.C. devices

7.0 "MODERN" PHYSICS

- 7.1 Models of the atoms
 - 7.1.1 Discuss the early concepts of the atom (Democritus, Dalton, etc.)
 - 7.1.2 Discuss the details of the Thompson model of the atom
 - 7.1.3 Describe the Rutherford atom and the experiment which led to its acceptance and discuss the predictions of classical physics that the Rutherford atom should collapse
 - 7.1.4 Discuss the Bohr model of the atom
 - 7.1.5 Discuss the quantum mechanical theory of atomic structure

7.2 Atomic particles

- 7.2.1 Discuss the early experiments concerning the discovery of the electron and properties of the electron
- 7.2.2 Discuss the properties and characteristics of the neutron and proton
- 7.2.3 Discuss the wave-particle duality exhibited by material particles
- 7.2.4 Discuss the production and characteristics of x-rays

7.3 Radioactivity

- 7.3.1 Review the discovery and early history of radioactivity
- 7.3.2 Discuss the types of particles emitted by nuclei, their characteristics and methods of detection
- 7.3.3 Define the term half-life and calculate the fraction of atoms or activity left after an integral number of half-lives
- 7.3.4 Define the terms atomic number, mass number, nucleon, nuclide and isotope
- 7.3.5 Define the terms nuclear binding energy and average binding energy per nucleon and explain the processes of fission and fusion
- 7.3.6 Write nuclear reaction equations describing nuclear processes and explain their meaning in words
- 7.3.7 Discuss the operating principle of a nuclear reactor for the production of energy; detail the advantages and disadvantages of the process
- 7.3.8 Discuss the interaction of high-energy photons with matter (photoelectric, Compton and pair-production)
- 7.3.9 Identify and list the characteristics of the elementary particles and discuss methods of detection and production

7.4 Relativity

- 7.4.1 Discuss length contraction and time dilation
- 7.4.2 Discuss the equivalency between mass and energy as expressed by formula $E = mc^2$
- 7.4.3 Discuss rest mass and relativistic mass as expressed by the formula

$$\frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} = m$$

Chapter IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The conclusions resulting from this study are listed below.

1. The items of competencies included in Chapter III of this study were accepted by the vast majority of responding science teachers as desirable expectations of the public elementary and secondary students of Mississippi; however, many of the competencies for a particular grade level or subject area appear to be directed toward the average or the above average student.

2. A discrepancy existed between what was reported from local school districts as being taught in the public schools and what actually was taught during the 1973-74 school year.

3. Many of the competencies that teachers indicated as desirable for one grade level were repeated in subsequent grade levels.

4. No single source of instructional materials seemed to be available to cover adequately the competencies for any one grade level or subject area in science.

5. An array of diverse opinions by responding science teachers were expressed concerning (1) the topics that were offered within particular courses, (2) the very courses that were offered, and (3) the sequence of courses that were offered in grades seven, eight, and nine.

6. Of the opinions expressed by responding teachers the overwhelming majority were favorable toward the development of a compilation of competencies in the field of science.

Recommendations

The recommendations resulting from this study are listed below.

1. The catalog of competencies resulting from this study should be utilized at the discretion of personnel in local school districts for the improvement of the instructional programs in science.
2. The catalog of competencies resulting from this study should be utilized in the development of an evaluation procedure for determining the effectiveness of science programs in Mississippi.
3. Closer scrutiny should be given to reporting procedures which identify the various courses offered in the public schools of Mississippi.
4. A further refinement of the statements of competencies should be undertaken to establish the validity of each competency for each grade level and subject area in the field of science.
5. Personnel from each local school district should acquire and/or develop resource materials centered around the science competencies that they select.
6. Activities should be conducted which result in the development of catalogs of competencies for each of the fields of study offered in the public elementary and secondary schools of Mississippi.

APPENDIX A
LETTER TO SUPERINTENDENTS



State of Mississippi

DEPARTMENT OF EDUCATION

JACKSON 39208

G. H. JOHNSTON
SUPERINTENDENT

Dear

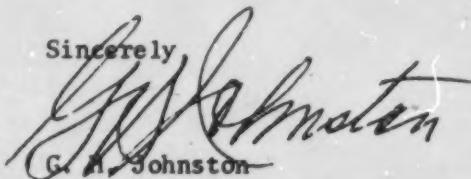
You will remember that in 1972 a statewide needs assessment was conducted by the State Department of Education, and in 1973 goals were adopted to meet the identified needs. The goal ranked highest in priority was for students "To acquire cognitive (intellectual) achievement in the basic academic skills (reading, mathematics, science, etc.) and/or the basic vocational-technical skills (woodworking, welding, drafting, etc.)." To develop the objectives for meeting this goal, participation by subject area specialists is a necessity. A pilot program (hopefully an exemplary program) is currently being planned for the subject area of science.

from your district has been chosen to participate in this program and will be receiving an invitation to participate within a few days. Two work days are anticipated for this participation. Your cooperation for releasing this individual for two days will be greatly appreciated.

The end result of the activities of the subject area specialists will be a printed catalog showing the competencies expected of students by the time a particular level or a particular subject within the area of science is completed. These catalogs will be reproduced and ultimately made available to every public school in Mississippi.

Thank you in advance for cooperating with the State Department of Education in this important endeavor.

Sincerely,


G. H. Johnston

APPENDIX B
INVITATION TO TEACHERS



State of Mississippi

DEPARTMENT OF EDUCATION
JACKSON 39205

G. H. JOHNSTON
SUPERINTENDENT

Dear

You have been selected as one of forty-one science area specialists across the state of Mississippi to participate in a program designed to identify the competencies expected of students in a science program after one year at a particular grade level or subject taught. To explain further let me inform you about our "Continuing Plan for Education in Mississippi." In 1972 a state-wide needs assessment was conducted by the State Department of Education utilizing over 4,000 Mississippians to identify educational needs for Mississippi. From this study forty-four high priority needs were determined. In 1973 a statewide survey was conducted by the State Department of Education utilizing 1,296 Mississippians to develop, adopt, and rank educational goals based upon the needs previously identified. Resulting from this study thirty-four educational goals for Mississippi were adopted. The goal ranked highest in priority was for students "To acquire cognitive (intellectual) achievement in the basic academic skills (reading, mathematics, science, etc.) and/or the basic vocational-technical skills (woodworking, welding, drafting, etc.)."

We are now ready to embark upon the third phase of our "Continuing Plan for Education in Mississippi" which is to develop specifically stated objectives for accomplishing the adopted goals and more specifically for accomplishing the number one ranked goal. To initiate the third phase of our state plan a pilot program (hopefully an exemplary program) is currently being planned for the subject area of science. It is for this project that we are soliciting your professional help.

We would like to issue you this invitation to participate in the development of competencies expected of students by the time a year's study in a particular science area is completed. Samples of competencies for the elementary level (grades 1-6) are as follows:

1. Name the four seasons of the year.

2. Describe three signs of each of the four seasons of the year.
3. Demonstrate the law of magnets.

Samples of competencies for the subject area of biology are as follows:

1. Diagram a three-link food chain.
2. Identify three types of community relationships found in a biotic environment.
3. Draw a diagrammatic representation of the blood circulation in man.

You are being asked to participate as a member of a group of _____ people in the science area of _____ to develop a list of competencies expected of those students by the time one year is completed.

A meeting will be held at 1:00 p.m. in Room 137 at the Research and Development Center in Jackson, Mississippi, on January 30, 1974. The following day, January 31, all participants will meet at 8:30 a.m. to continue identifying competencies. Your superintendent has been notified of your selection and has been asked to release you for two days for this activity. Please confer with your superintendent about this matter. You will need to bring with you all items which might help you to identify the expected competencies of students in your assigned subject area or grade level, for example, text books, workbooks, accumulated test questions, compilations of objectives, courses of study, lesson plans, and all other materials specifying content.

The conference directors will be Mr. R. C. Roberts and Mr. Jim Hancock, science supervisors for the State Department of Education. They will be participating not only in this meeting but also in all subsequent activities related to the overall project. With full cooperation by all participants this project can truly be an exemplary program worthy of not only state recognition but also national recognition.

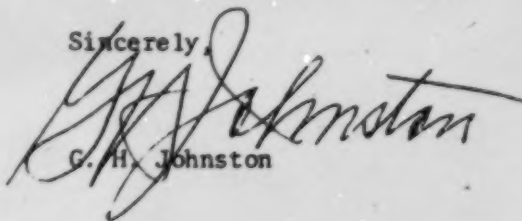
For participating in this pilot project you will be reimbursed for your travel expenses, hotel room, and meals. In addition you will receive a daily stipend of \$25.00 for your professional services. If requested, a hotel room will be reserved for you.

The end result of the activities in which you and the other forty subject area specialists will be involved will be a printed catalog showing the competencies expected of students by the time one year is completed in a particular level or subject area in the field of science. These catalogs will be reproduced and ultimately made available to every public school in Mississippi. I hope that you can see from this activity that we can then proceed to measure how well the stated competencies are being achieved across the state in the area of science. Then, if necessary, we can make educational changes based upon sound evaluation data.

Please complete the "invitation form" provided and return it in the enclosed pre-stamped envelope by January 18, 1974. If you have any questions concerning this project, please contact Dr. Jerry Hutchinson, Coordinator, Office of Planning and Evaluation, Mississippi State Department of Education, Box 771, Jackson, Mississippi, 39205 or phone 354-7328.

Thank you in advance for cooperating with the State Department of Education in this important endeavor.

Sincerely,


G. H. Johnston

GHJ/bb

Enclosures

INVITATION FORM

THE MISSISSIPPI STATE DEPARTMENT
OF EDUCATION

invites you to participate in
A SPECIAL SCIENCE WORK CONFERENCE

JANUARY 30 AND 31, 1974

RESEARCH AND DEVELOPMENT CENTER
JACKSON, MISSISSIPPI

RSVP

PLEASE RETURN

☐ I will attend

☐ I will not attend

NAME: _____

TELEPHONE(S): Home _____ Office _____

☐ Please make a hotel reservation for me at the Holiday Inn Medical Center, 2375 North State Street, Jackson, Mississippi, for (check nights) ☐ Tuesday, January 29, ☐ Wednesday, January 30, and/or ☐ Thursday, January 31, 1974.

☐ I will make my own arrangements.

APPENDIX C
SCIENCE WORK CONFERENCE AGENDA

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SCIENCE WORK CONFERENCE AGENDA

Wednesday, January 30, 1974

- I. Opening session for group chairmen - 9:00 a.m., Room 137
 - A. Welcoming remarks and introductions
 - B. Background information pertaining to the "Continuing Plan for Education in Mississippi"
 - C. Discussion of the ultimate goal for the conference
 - D. Discussion of the potential outcomes of the project
 - E. Organization of the conference
 - F. Discussion of the role of the chairmen in the project
 - G. Explanation of the financial arrangements
 - H. Assignment of rooms for group meetings
- II. Opening session for all conference participants - 1:00 p.m., Room 137
 - A. Welcoming remarks by Dr. Garvin H. Johnston, State Superintendent of Education
 - B. Introduction of staff
 - C. Background information pertaining to the "Continuing Plan for Education in Mississippi"
 - D. Discussion of the ultimate goal for the conference
 - E. Discussion of the potential outcomes of the project
 - F. Organization of the conference
 - G. Discussion of the role of the chairmen and participants in the project
 - H. Explanation of the financial arrangements
 - I. Assignment of rooms for group meetings
- III. First group meeting - 2:30 p.m. to 4:30 p.m.

- A. Develop subject area into topical outline
- B. Begin identifying and listing competencies under each topic

Thursday, January 31, 1974

- IV. General assembly - 8:30 a.m., Room 137
 - A. Answer questions
 - B. Explain agenda for the day
- V. Second group meeting - 9:00 a.m. to 11:30 a.m.
(To continue identifying competencies under identified topics)
- VI. Meeting with chairmen - 11:30 a.m., Room 137
 - A. Determine progress of groups
 - B. Discuss alternative plan
- VII. Third group meeting - 1:00 p.m. to 4:00 p.m.
(To continue identifying competencies under identified topics)
- VIII. Final general assembly - 4:00 p.m.

APPENDIX D
LETTER TO SUPERINTENDENTS



State of Mississippi

DEPARTMENT OF EDUCATION

JACKSON 39205

G. H. JOHNSTON
SUPERINTENDENT

Dear

To keep you fully informed about the development of the "Continuing Plan for Education in Mississippi," this letter and its attachments are being sent to you for your information. The Mississippi State Department of Education has embarked upon the third phase of our program which is to develop specifically stated objectives for accomplishing the educational goals identified in phase two. Initially, we are in the process of identifying the competencies expected of students in the field of science from grades one through twelve. These competencies are an enumeration of the specific expectations of students by the time a year's study in a particular science area is completed.

Through the principals of your schools, we are soliciting professional contributions from the science teachers within your district to develop catalogs of competencies in the field of science. Attached is a copy of the request being sent to each principal in your school district.

I would like to take this opportunity to thank you for the cooperation that has been extended in the past in the development of the "Continuing Plan for Education in Mississippi" and to thank you in advance for cooperating with the State Department of Education in this important third phase.

Sincerely,

G. H. Johnston
State Superintendent of Education

GHJ/bj

Enclosures

APPENDIX E
LETTER TO PRINCIPALS



State of Mississippi

DEPARTMENT OF EDUCATION
JACKSON 39205

G. H. JOHNSTON
SUPERINTENDENT

April 1, 1974

Dear

The Mississippi State Department of Education is earnestly soliciting your cooperation in the development of phase three of the "Continuing Plan for Education in Mississippi." In 1972 a statewide needs assessment, phase one, was conducted by the State Department of Education utilizing over 4,000 Mississippians to identify educational needs for Mississippi. From this study forty-four high priority needs were determined. In 1973 a goals study, phase two, was conducted by the State Department of Education utilizing 1,297 Mississippians to develop, adopt, and rank educational goals based upon the needs previously identified. Resulting from this study thirty-four educational goals for Mississippi were adopted. The goal ranked highest in priority was for students "To acquire cognitive (intellectual) achievement in the basic academic skills (reading, mathematics, science, etc.) and/or the basic vocational-technical skills (woodworking, welding, drafting, etc.)."

As of January, 1974, we have embarked upon the third phase of our "Continuing Plan for Education in Mississippi" which is to develop specifically stated objectives for accomplishing the adopted goals. We are initially working on one part of phase three in relation to the number one goal mentioned above. Currently we are developing the competencies expected of students in the field of science from grades one through twelve. These competencies are an enumeration of the specific expectations of students by the time a year's study in a particular science area is completed. During January, 1974, selected science teachers representing all areas of science for grades one through twelve met for a science work conference. At this work conference a list of potential competencies for each subject area and grade level of science was developed.

You and your science faculty are being asked to participate in the development of these competencies which were initially identified at the science work conference. Enclosed you will find separate lists of competencies, one for each of the grade levels and subject areas checked below.

Primary Level

Level 1 _____
Level 2 _____
Level 3 _____

Intermediate

Level 4 _____
Level 5 _____
Level 6 _____

Junior High General Science

General Science (7) _____
General Science (8) _____
General Science (9) _____

Junior High Science

Life Science (7) _____
Earth and Space Science (8) _____
Physical Science (9) _____

High School Science

Biology _____
Marine Biology _____
Chemistry _____
Physics _____
Advanced Physical Science _____

You will note that opposite each listed competency included in the enclosed materials is a space provided to indicate if that competency would be a desirable or an undesirable expectation for a student enrolled in that grade level or subject area. Also, space is provided at the end of the form for a listing of additional topics and competencies that should be required or expected of students in that particular area.

You, as principal of this school, are essential to the success of phase three of this program. You are being asked to distribute the enclosed lists of competencies to the appropriate faculty members of your school to review, mark, and make additions. It is our desire that each teacher who has a responsibility in the subject area indicated herein be given a chance to examine the proposed list of competencies. When you have more than one teacher representing a particular subject or grade level please ask that a consensus be expressed in the response. Also, please collect the completed lists and return each of the enclosures to us in the pre-stamped, addressed envelope which is enclosed. A return of these lists by April 15, 1974, will be greatly appreciated.

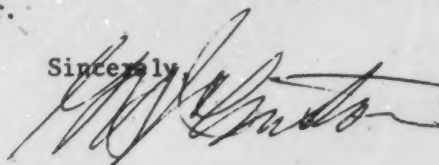
Upon compiling the returns from across the state, science catalogs will

be produced which contain the expected competencies of students in the science courses listed above which are taught in the public schools of Mississippi. These competencies will be determined by the science teachers of Mississippi. The resulting catalogs will be made available to every public school in Mississippi. The implications for having this type of information can be great for the improvement of the educational process of students in this state. I hope that you can see from this activity that we can then proceed to phase four of the "Continuing Plan for Education in Mississippi" which is to measure how well the stated competencies are being achieved across the state in the area of science. Then, if necessary, we can make educational changes based upon sound evaluation data.

If you have any questions concerning this project, please contact Dr. Jerry Hutchinson, Coordinator, Office of Planning and Evaluation, Mississippi State Department of Education, Post Office Box 771, Jackson, Mississippi, 39205 or phone 354-7328.

Thank you in advance for cooperating with the State Department of Education in this important endeavor.

Sincerely,



G. H. Johnston
State Superintendent of Education

GHJ:bb

Enclosures

APPENDIX F

A SAMPLE OF PROPOSED COMPETENCIES

PROPOSED COMPETENCIES FOR
ELEMENTARY SCIENCE
LEVEL 1

DIRECTIONS FOR ASSESSING PROPOSED COMPETENCIES

Background

A four-phase educational plan called the "Continuing Plan for Education in Mississippi" is being conducted by the Mississippi State Department of Education (SDE) over a multi-year period. In 1972 a statewide needs assessment, phase one, was conducted by the SDE utilizing over 4,000 Mississippians to identify educational needs for Mississippi. In 1973 a goal study, phase two, was conducted by the SDE utilizing 1,297 Mississippians to develop, adopt, and rank educational goals based upon the needs previously identified. Resulting from this study thirty-four educational goals for Mississippi were adopted. The goal ranked highest in priority was for students "To acquire cognitive (intellectual) achievement in the basic academic skills (reading, mathematics, science, etc.) and/or the basic vocational-technical skills (woodworking, welding, drafting, etc.)."

In January, 1974, the SDE began the third phase of the "Continuing Plan for Education in Mississippi" which is to develop specifically stated objectives for accomplishing the adopted goals. The initial project in phase three is to develop the competencies expected of students in the field of science from grades one through twelve. This project is just one step in the process of accomplishing the number one goal. The competencies will be enumerations of the specific expectations of students by the time a year of study in a particular science area is completed. During January, 1974, forty-one selected science teachers representing all areas of science from grades one through twelve met for a science work conference. At this work conference an initial list of potential competencies for each subject area and grade level of science was developed. This list is being made available to you for your comment at this time.

Directions

You are being asked to participate in the development of competencies for the attached subject area of science. Your task can be completed as follows:

1. Indicate the number of teachers in your school who teach the attached level or subject area of science. _____
2. The opinions given concerning the competencies listed for this subject area are the consensus of how many of the teachers who teach this subject area in your school? _____
3. Each subject area is outlined in a numerical outline. The major topics are listed by numbers such as 1.0, 2.0, 3.0, etc. Under each major topic are sub-topics which relate to the major topics and are numbered 1.1, 1.2, 1.3, etc.; 2.1, 2.2, 2.3, etc.; 3.1,

3.2, 3.3, etc. The sub-topics may be further divided and numbered 1.1.1, 1.1.2, 1.1.3, etc. The last extremity of the outline will contain the competencies that students are expected to attain as related to the appropriate topic. Each competency will then be numbered in accordance with the appropriate topic.

4. To the right of each listed competency is provided a space for you to mark whether you agree or disagree that that particular competency is a desirable expectation of the students you teach in this particular subject area or grade level. Your approval or disapproval should reflect the consensus of opinions of the teachers in your school who teach this subject area or grade level.
5. Should you disagree with the stated terminology or content of a listed competency and desire to indicate a suggested revision, please make a note in the margin.
6. Space has been provided at the end of the form for the insertion of additional competencies that you feel should be included. When making your list of additional competencies, please attach the appropriate number to the competency so that it can be entered under the proper topic and sub-topic. Example: Under topic number 2.0 and sub-topic 2.1 you desire an additional competency. Suppose five competencies are listed under 2.1, the last being 2.1.5. Your additional competency would be numbered 2.1.6. Number all additional competencies accordingly. The same procedure would be used if you felt a needed sub-topic or topic was omitted. If under topic 2.0 there were three sub-topics, the last being 2.3, the additional sub-topic would be 2.4. Then you would list the expected competencies for this sub-topic as 2.4.1, 2.4.2, etc.
7. Upon completing the tasks described in items four, five, and six, please return the completed form to your principal. Your principal has been asked to collect all forms for all areas of science represented in this school and to return them to the State Department of Education.

The importance of this activity cannot be overemphasized. As you can see, the science teachers of the state of Mississippi will be determining what the outcomes in each course of science taught in Mississippi should be. After compiling the returns from across the state, catalogs will be produced which contain the expected competencies of students in science courses taught from grades one through twelve in the public schools of Mississippi. These catalogs will be made available to every public school in the state. The implications for having this type of information are infinite and can contribute to the improvement of the educational process of students. You can see from this activity that the SDE can then proceed to phase four of the "Continuing Plan for Education in Mississippi" and measure how well the stated competencies are being achieved across the state in the area of science. Then, if necessary, educational changes can be made based upon sound evaluation data.

Thank you in advance for contributing your professional services to this most important endeavor.

LEVEL 1

Agree Disagree

1. 1 Fish

- ## 2.0 PLANT LIFE

- ### 3.0 HUMAN BODY

- #### 4.0 ATMOSPHERIC SCIENCE

- ## 5.0 GEOLOGY

- 162

6.0 ASTRONOMY

6.1 Stars

- 6.1.1 Define a star
- 6.1.2 Recognize the sun as a star
- 6.1.3 Distinguish between sun's apparent and actual size in relation to other stars
- 6.1.4 Draw the Big and Little Dippers
- 6.1.5 Tell the differences between day and night stars
- 6.1.6 Distinguish among North and South and East and West

6.2 Shadows

- 6.2.1 Name the causes of shadows
- 6.2.2 Tell how shadows change

6.3 Tell or demonstrate what causes day and night

6.4 Indicate directions using sun or stars

7.0 ECOLOGY AND CONSERVATION

7.1 Plant

- 7.1.1 Discuss the role of forest fire prevention
- 7.1.2 Discuss the caring of helpful plants

7.2 Illustrate role of plants in soil conservation

7.3 Describe uses of dams and levees

7.4 Name contributors to air and water pollution

7.5 Apply methods of energy conservation

7.6 Tell why plants and animals need clean unpolluted air and water to stay alive and healthy.

7.7 Point out and discuss the kinds and causes of pollution - air and water.

8.0 CHEMISTRY

8.1 Identify, sort, and describe objects by their properties

8.2 Count materials composing a particular object.

8.3 Explain how water can change state but not composition

9.0 PHYSICS

9.1 Sound

- 9.1.1 Distinguish between sounds made by different objects
- 9.1.2 Demonstrate sound as vibration
- 9.1.3 Distinguish between pitches
- 9.1.4 Discuss noise pollution

9.2 Light

- 9.2.1 Name at least three different sources of light
- 9.2.2 Demonstrate that light is composed of many colors
- 9.2.3 Illustrate the colors of light in their proper sequence
- 9.2.4 Explain the necessity of light to plants.

9.3 Heat

- 9.3.1 List four uses of heat
- 9.3.2 Compile a list of four sources of heat
- 9.3.3 Show how thermometer measures heat.
- 9.3.4 Distinguish between conductive and nonconductive materials.
- 9.3.5 Describe objects in terms of hotter than or colder than the child's hand.

9.4 Magnetism

- 9.4.1 Demonstrate law of magnets.
- 9.4.2 Classify materials into magnetic and nonmagnetic.
- 9.4.3 List uses of magnets.
- 9.4.4 Induce magnetism into iron objects.
- 9.4.5 Show how magnetism passes through nonmagnetic materials

9.5 Name three simple machines

9.6 Identify simple machines by function

Additional Competencies: (Refer to directions and number the additional competencies appropriately; attach additional pages as necessary.)

APPENDIX G

FOLLOW-UP LETTER TO PRINCIPALS



State of Mississippi

DEPARTMENT OF EDUCATION

JACKSON 39205

April 30, 1974

G. H. JOHNSTON
SUPERINTENDENT

Dear

This letter is a follow-up to the request made of you on April 1, 1974, in which you were asked to distribute some packages containing proposed science competencies to the appropriate teachers in your school building. The purpose of this project was to provide all of the science teachers in the public schools of Mississippi the opportunity to develop a catalog of competencies in the subject area of science. Effective this date, we have not received the following lists of competencies which were sent to you:

Primary

Level 1 _____
Level 2 _____
Level 3 _____

Intermediate

Level 4 _____
Level 5 _____
Level 6 _____

Junior High General Science

General Science (7) _____
General Science (8) _____
General Science (9) _____

Junior High Science

Life Science (7) _____
Earth and Space Science (8) _____
Physical Science (9) _____

High School Science

Biology _____
Marine Biology _____
Chemistry _____
Physics _____
Advanced Physical Science _____
Earth and Space Science _____

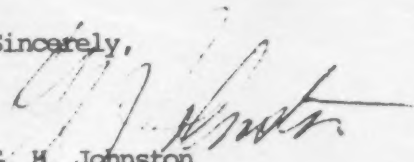
April 30, 1974
Page 2

We are still very interested in obtaining the reactions of your science teachers to the proposed competencies and would greatly appreciate your time in looking into this matter. It is important to obtain a high percentage of returns in order to develop a complete catalog reflecting the contributions of science teachers concerning what should be expected of students by the time a particular course in science is completed. This catalog is scheduled to be ready for use beginning with the 1974-75 school year.

If inappropriate materials were sent to you or if the materials have been inadvertently misplaced or lost in the mail, please request additional copies from Dr. Jerry Hutchinson, Coordinator, Office of Planning and Evaluation, Mississippi State Department of Education, Post Office Box 771, Jackson, Mississippi 39205 or phone 354-7328.

Once again, we appreciate your cooperation with the State Department of Education in this important endeavor.

Sincerely,



G. H. Johnston

State Superintendent of Education

GHJ/bj

APPENDIX H

PROPOSED COMPETENCIES REJECTED BY
RESPONDING SCIENCE TEACHERS

APPENDIX H

PROPOSED COMPETENCIES REJECTED BY
RESPONDING SCIENCE TEACHERSLEVEL ONE

- 5.3 Identify properties of rocks and sort according to these named properties
- 8.2 Count materials composing a particular object
- 9.2.3 Illustrate the colors of light in their proper sequence
- 9.3.4 Distinguish between conductive and nonconductive materials

LEVEL TWO

- 4.1.2 Estimate the height of cloud patterns

LEVEL THREE

No deletions

LEVEL FOUR

No deletions

LEVEL FIVE

No deletions

LEVEL SIX

No deletions

GENERAL SCIENCE (LEVEL SEVEN)

No deletions

LIFE SCIENCE (LEVEL SEVEN)

- 5.1.4.4 Describe the formation of ionic bonds
- 5.1.4.6 Describe the formation of covalent bonds

GENERAL SCIENCE (LEVEL EIGHT)

No deletions

EARTH AND SPACE SCIENCE (LEVEL EIGHT)

No deletions

GENERAL SCIENCE (LEVEL NINE)

No deletions

PHYSICAL SCIENCE (LEVEL NINE)

No deletions

BIOLOGY

No deletions

MARINE BIOLOGY

No deletions

EARTH AND SPACE SCIENCE (HIGH SCHOOL)

- 1.1.2.3 Give the oxidation-reduction number of at least twenty-five common elements and radicals
- 4.1.3 Compute the amount of sea water needed to give a specified amount of magnesium metal

ADVANCED PHYSICAL SCIENCE

No deletions

CHEMISTRY

No deletions

PHYSICS

No deletions

APPENDIX I

ADDITIONAL COMPETENCIES SUGGESTED BY
RESPONDING SCIENCE TEACHERS

APPENDIX I

ADDITIONAL COMPETENCIES SUGGESTED BY RESPONDING SCIENCE TEACHERS

LEVEL ONE

- 1.2.6 Describe how frogs move during each stage of their life cycle
- 1.6 Group common animals into land animals and/or water animals
- 1.7 Reptiles
 - 1.7.1 Tell how the earth looked millions of years ago with prehistoric animals abounding
 - 1.7.2 Explain how fossils have helped us learn about the past
 - 1.7.3 Name and identify at least two dinosaurs
- 1.8 Distinguish between domestic animals and wild animals
- 1.9 Name three household pets
- 1.10 Describe an insect
- 2.11 Describe the use of air by plants for growth
- 2.12 Describe some poisonous plants found in the southeast United States
- 3.7 Identify the five senses and describe their uses
- 3.8 Describe the requirements for growth of the human body
- 3.9 Explain how smoking tobacco and drinking alcoholic beverages may harm the body
- 3.10 Safety
 - 3.10.1 Relate safety to being "well" and "happy"
 - 3.10.2 Describe safety practices for traveling to and from school
 - 3.10.3 Describe safety practices on the playground
- 4.8 Define fog
- 4.9 Draw and explain the water cycle
- 4.10 Discuss terms used to describe air in motion - breeze, gale, hurricane, etc.
- 4.11 Demonstrate how air takes up space and has weight
- 4.12 Explain how doctors, astronauts, and divers use oxygen in their occupations
- 4.13 Name ways winds can be destructive
- 4.14 Clean air - dirty air
 - 4.14.1 List things in a community which causes air to be dirty
 - 4.14.2 Describe how we can determine if air is dirty
 - 4.14.3 Name some places where one might expect to find clean air
- 6.5 Solar system
 - 6.5.1 Name the center of our solar system
 - 6.5.2 Name the major planets of the solar system
 - 6.5.3 Describe the moon
 - 6.5.4 Observe the phases of the moon
 - 6.5.5 Understand that the earth receives energy from the sun in the form of light and heat
- 6.6 Distinguish among North, South, East, and West on a map
- 7.8 Relate the extinction of some animals to man's carelessness
- 8.3 Demonstrate that heat aids in evaporation
- 8.4 Demonstrate that water evaporates into the atmosphere
- 8.5 Distinguish among various groups of materials such as metals, nonmetals, gases, etc.
- 9.1.5 Distinguish among simple sounds such as high and low frequency, great or small amplitude, etc.
- 9.1.6 Describe the difference between sounds that are pleasant and noise
- 9.1.7 Discuss how sounds are received by the ear
- 9.1.8 Describe the major parts of the ear and how they function to enable a person to hear
- 9.7 Discuss safety precautions that should be employed with the use of machines
- 9.8 Describe the types of injuries that may be caused by machines
- 10.0 Archeology
 - 10.1 Describe the Ice-Age
 - 10.2 Name some of the prehistoric animals
 - 10.3 Define fossil
- 11.0 Time-Space Relationship
 - 11.1 Name the visual parts of a clock
 - 11.2 Explain the value of knowing how to tell time
 - 11.3 Demonstrate how to tell time
- 12.0 Measurement
 - 12.1 Demonstrate how to measure length, width, time, and liquids

LEVEL TWO

- 1.1.5 Name the principle parts of an insect
- 1.1.6 Describe how insects are helpful to man
- 1.1.7 Discuss the life cycle of fruit flies

- 1.2.4 Discuss the migration of birds
- 1.2.5 Observe how different birds live and what their habits are
- 1.2.6 Discuss the shapes and sizes of nests of various birds
- 1.2.7 Name some birds that are consumed by man
- 1.2.8 Discuss birds as pets
- 1.2.9 Name ways birds help man
- 1.2.10 Compare feet and beak of different birds
- 1.2.11 Know our state bird
- 1.3.4 Name some mammals found in the forest and around home
- 1.3.5 Know the characteristics of mammals
- 1.3.6 Discuss the hibernation of some mammals
- 1.3.7 Discuss the food value of mammals to man
- 1.3.8 Discuss mammals as pets
- 1.3.9 Compare land mammals and water mammals
- 1.3.10 Observe different mammals in their habitats
- 1.4.4 Name some amphibians that are edible by man
- 1.5 Reptiles
 - 1.5.1 Know that dinosaurs were ancient reptiles
 - 1.5.2 Name some reptiles that have survived eons of changes
 - 1.5.3 Name five kinds of dinosaurs
 - 1.5.4 Know the difference between plant-eaters and meat-eaters
 - 1.5.5 Name three characteristics of reptiles
- 1.6 Fish
 - 1.6.1 Identify three types of fish
 - 1.6.2 Name three characteristics of fish
 - 1.6.3 Maintain an aquarium
 - 1.6.4 Observe the activities of a fish in an aquarium
- 1.7 Mollusks
 - 1.7.1 Name three kinds of mollusks
 - 1.7.2 Name three characteristics of mollusks
 - 1.7.3 Describe how an oyster grows
- 1.8 Echinoderms
 - 1.8.1 Describe the life cycle of the starfish
 - 1.8.2 Discuss the regeneration ability of the starfish
 - 1.8.3 Describe the eating habits of the starfish
 - 1.8.4 Relate the starfish as a pest to man
- 2.1.7 Identify six common trees by the shape of their leaves
- 2.1.8 Know the two types of trees
- 2.1.9 Observe the development of a pine cone from bloom to mature cone
- 2.1.10 Observe the development of stem, roots, and leaves of a tree
- 2.1.11 Log a weekly review of plant growth in the classroom
- 2.1.12 Describe the different parts of plants that man uses as food
- 2.1.13 Discuss the different kinds of plants found in different environments
- 3.3.4 Explain the importance of exercise and the right amount of sleep and rest as related to growth in humans
- 3.4.6 Discuss alcohol as a cause of serious conditions and disease of the body
- 3.4.7 Explain the harmful effects attributed to smoking tobacco
- 3.5.3 Discuss safety in the home
- 3.5.4 Discuss safety around and in swimming areas
- 3.5.5 Describe safety practices for the classroom
- 3.6 How your body moves
 - 3.6.1 Know that bones make up skeletons
 - 3.6.2 Know that different bones have different functions
 - 3.6.3 Know that muscles attach to bones and produce movement
 - 3.6.4 Know how joints between bones provide movement
- 4.1.10 Know what materials compose air
- 4.1.11 Know the causes of wind
- 4.1.12 Explain the causes of the seasons such as summer, fall, winter, and spring
- 4.1.13 Describe changes in clothing habits necessary for different seasons of the year
- 4.2.7 Observe various kinds of soil such as humus, clay, sand, etc.
- 4.2.8 Collect and observe various kinds of rocks
- 5.1.10 Know that up is away from the earth and down is toward the earth
- 5.1.11 Describe how the earth is like other space ships traveling in space
- 5.5 Discuss the vastness of the solar system
- 5.6 Planets
 - 5.6.1 Name the planets in the solar system
 - 5.6.2 Name the largest planet and the smallest planet in our solar system
 - 5.6.3 Define the term constellation
- 5.7 Name three instruments used in astronomy
- 6.4.6 Discuss littering

- 7.4 Demonstrate the interaction of matter
- 7.5 Describe what causes interaction within matter
- 7.6 Define the term molecule
- 7.7 Draw a picture showing models of molecules
- 7.8 Explain that all things are made of molecules
- 8.1.9 Construct a system of objects to demonstrate interaction of magnets
- 8.1.10 Observe objects that interact at a distance with magnets
- 8.3.8 Show that light will travel in a straight line
- 8.4.7 Explain how sound travels through air
- 8.4.8 Discuss how sound is interpreted through the ear and brain
- 8.4.9 Demonstrate that sound travels through solids, liquids, and gases
- 8.4.10 Explain why sound is not heard on the moon

LEVEL THREE

- 1.1.6 Generalize about various aquatic forms of animals
- 1.2.8 Explain the gill function in relationship to other types of respiration
- 1.2.9 Learn relationship of fishes to older forms of animals
- 1.3.8 Understand the existence of unusual sensory power of birds as related to migration
- 1.3.9 Recognize the variation in nesting habits of birds and the care of their young
- 1.3.10 Recognize three major birds of Mississippi
- 1.4.9 Learn three characteristics peculiar to mammals
- 1.6 Vertebrates and invertebrates
 - 1.6.1 Understand the difference between vertebrates and invertebrates
 - 1.6.2 List five vertebrates and five invertebrates
 - 1.6.3 Construct a model of a spine
- 2.1.4 Discuss plants without tubes
- 2.2.13 Discuss plants with tubes and cones
- 2.2.14 Demonstrate the importance of anchorage for plants
- 2.2.15 Show how flowers are different from plant to plant
- 2.2.16 Demonstrate structural relationships of common plants to each other
- 2.3.6 Associate the difference among trees with adaptations to their environment
- 3.13 Describe the basic principles of reproduction in humans and compare to other living organisms - plant and animal
- 3.14 Give the basic raw materials needed by the human body for assimilation
- 3.15 Describe the basic parts of the cell
 - 3.15.1 Give the function of the nucleus
 - 3.15.2 Give the function of the cell membrane
 - 3.15.3 Give the function of the cytoplasm
- 3.16 Recognize the four basic food groups
- 3.17 Explain the importance of proper care and maintenance of the human body
- 4.3 Describe the use of antibiotics
- 4.4 Identify two diseases which may be treated with drugs other than antibiotics
- 4.5 Know of drug abuse prevention programs in your school or locale
- 5.1.7 Demonstrate air pressure
- 5.2.13 Describe the formation of fog
- 6.1.10 Name the nine planets in our solar system
- 6.1.11 Explain earth's ability to support life as we know it as opposed to other planets in our solar system relative to distance from the sun
- 8.1.7 List causes and effects of water pollution
- 8.1.8 Demonstrate erosion and its effects on the environment
- 8.2.4 Discuss the importance of air to living organisms
- 8.2.5 Show how air masses affect air pollution
- 8.3.3 Discuss methods of conserving wildlife
- 10.3.3 Explore the sources of sound pollution
- 10.3.4 Illustrate the ability of organisms to detect sound vibrations
- 10.4 Machines
 - 10.4.1 Discuss the concept of a simple machine such as the lever, wedge, screw, etc.

LEVEL FOUR

- 1.1.10 Know the parts of a plant
- 1.1.11 Know three kinds of desert plants

- 1.1.12 Explain the basic processes involved in photosynthesis
- 1.1.13 Describe the composition of fertile soil
- 1.1.14 Explain the function of fertilizers as they relate to plants
- 1.1.15 Know three common spring and three common fall wildflowers
- 1.1.16 Know ten common trees
- 1.1.17 Compare the seeds, pods, cones and size of four common trees
- 1.1.18 Maintain a terrarium
- 1.1.19 Know four groups of simple plants that do not reproduce by seeds
- 1.1.20 Recognize the principal stages in the life cycle of common plants and relate these stages to food for animals
- 1.1.21 Know that green plants use the sun's energy during the food-making process
- 1.1.22 Show that plants need water, minerals, air and sunlight in order to grow
- 1.1.23 Demonstrate how plants contain, use and give off water
- 1.1.24 Know examples of plants that grow from parts of a plant other than a seed
- 1.1.25 Know the principal parts of a flower
- 1.1.26 Distinguish between simple and compound leaves
- 1.1.27 Discuss the survival problems of plants
- 1.1.28 Know the two large groups into which scientists classify most plants
- 1.1.29 Describe how petrified wood is formed
- 1.1.30 Explain the difference between microscopic plants and animals
- 1.2.8 List the characteristics of vertebrates and invertebrates
- 1.2.9 Group vertebrates into: mammals, birds, reptiles, amphibians, and fish
- 1.2.10 List the characteristics of each class of vertebrate
- 1.2.11 Describe the work of a biologist
- 1.2.12 Name three animals that regenerate body parts
- 1.2.13 Know the five groups of vertebrate animals
- 1.2.14 Know ten common mammals of the local area
- 1.2.15 Name the common birds of the local area
- 1.2.16 Identify the common insects of the local area
- 1.2.17 Name those insects that are helpful and those that are harmful found in the local area
- 1.2.18 Establish an aquarium of native fish
- 1.2.19 Recognize that animals adapt for life in the environment they inhabit
- 1.2.20 Define the terms: adaptation, environment, habitat, and behavior
- 1.2.21 Describe the life cycle of five native animals
- 1.2.22 Know four ways plants and animals are alike
- 1.2.23 Describe three groups of reptiles
- 1.3.10 Know the two layers of the skin
- 1.3.11 Know that a group of organs comprise a body system
- 1.3.12 Recognize that growing up emotionally is accomplished by changes in attitudes and interests
- 1.3.13 Know some basics of care and grooming of the body
- 1.3.14 Discuss the blood circulation through the heart
- 1.3.15 Describe the effects of space travel on the body
- 1.3.16 Know the functions of the outer and inner layers of the skin
- 1.3.17 Discuss drugs related to the body
 - 1.3.17.1 Dramatize how to refuse to take a "dose" to experiment with the use or misuse of tobacco, alcohol, or dangerous drugs
 - 1.3.17.2 Discuss ways society attempts to regulate the use of drugs through legal channels
 - 1.3.17.3 Describe the action to take if a person has taken a dangerous drug
 - 1.3.17.4 Relate the effects of tobacco, alcohol, and drugs on the human body
- 2.1.13 Recognize the different cloud forms
- 2.1.14 Illustrate the water cycle
- 2.1.15 Know the differences among the various types of climate
- 2.2.8 Understand the importance of conserving the earth's resources
- 2.2.9 Know how rocks are classified
- 2.2.10 Demonstrate skill in using latitude and longitude to locate positions on a globe and/or map
- 2.2.11 Describe the composition of topsoil
- 2.2.12 Know the three classes of rock
- 2.2.13 Discuss volcanoes and earthquakes
- 2.2.14 Identify the rock formed by cooling of lava
- 2.2.15 Describe the processes of faulting and folding
- 2.2.16 Know the time zones of North America
- 2.3.11 Know the order and at least one distinguishing characteristic of each planet in our solar system
- 2.3.12 Locate the major constellations
- 2.3.13 Demonstrate the causes of the shapes of the moon we observe
- 2.3.14 Know the period of rotation for the moon
- 2.3.15 Relate the gravitational force of the earth to the moon's motion
- 3.1.9 Recognize that sound-proofing materials absorb sound waves to control acoustics
- 3.1.10 Know the speed of sound in air
- 3.1.11 Describe how an echo is produced
- 3.1.12 Show the ways sound helps us in every day living
- 3.1.13 Name the major parts of the ear

- 3.2.12 Distinguish between luminous and reflected light
- 3.2.13 Demonstrate reflection and diffusion of light
- 3.2.14 Show the ways light helps us in every day living
- 3.2.15 Know that rough objects diffuse light
- 3.2.16 Know primary and secondary colors
- 3.3.9 Define the term properties
- 3.3.10 Define the terms element and compound
- 3.4.8 Know the difference between a closed circuit and an open circuit
- 3.4.9 Describe ways we use electricity in every day living
- 3.5 Machines
 - 3.5.1 Identify four simple machines
 - 3.5.2 Differentiate between a simple machine and a complex machine
- 4.0 Demonstrate how to use a microscope
- 5.0 Use the metric system in measuring and communicating data about scientific investigations
- 6.0 Conservation and Ecology
 - 6.1 Describe three water treatment methods
 - 6.2 Demonstrate a method of water purification
 - 6.3 Discuss alternate methods of correcting air pollution
 - 6.4 Define the term ecology
 - 6.5 Discuss the interdependency of man with other living things
 - 6.6 Relate the importance of the carbon cycle to food chains
 - 6.7 Discuss the sources of energy and their relationship to man's activities
- 7.0 Safety
 - 7.1 Know three things needed for a fire to continue burning
 - 7.2 Know how to extinguish a fire
 - 7.3 Relate fire drills to safety
 - 7.4 Recognize how to handle safely chemicals found in the home and classroom
- 8.0 Know the structure of the oxygen molecule
- 9.0 Explain the oxidation process

LEVEL FIVE

- 1.1.14 Relate plants to other organisms considering food chains
- 1.1.15 Describe plant cell division
- 1.1.16 Know what hydroponics are
- 1.1.17 Associate the terms monocot and dicot with stems
- 1.1.18 Describe how seeds are produced in cones
- 1.1.19 Relate ferns growth to their habitats
- 1.1.20 Describe the plant association known as lichens
- 1.1.21 Know the difference between evergreen and deciduous trees
- 1.1.22 Identify plants of the local area
- 1.1.23 Name the four major plant groups and their major characteristics
- 1.1.24 Name and give the function of each part of the plant cell
- 1.1.25 Identify the parts of a typical flower
- 1.2.10 Know that all living things carry on life processes
- 1.2.11 Associate the prehistoric animals with the order of their prominence on the earth
- 1.2.12 Compare the obvious changes of one group of prehistoric animals to those of other animals
- 1.2.13 Describe the function of two kinds of cells in sponges
- 1.2.14 Know how sponges maintain their shape
- 1.2.15 Know how jellyfish, starfish and mollusks get their food
- 1.2.16 Relate the earthworm to farming
- 1.2.17 Know that most lower animals have water habitats
- 1.2.18 Describe the life cycle of a butterfly
- 1.2.19 Define the terms exoskeleton and arthropods
- 1.2.20 Distinguish between spiders and insects
- 1.2.21 Know the body regions of an insect
- 1.2.22 Know the function of gills, fins and scales of fish
- 1.2.23 Know the meaning of the terms cold-blooded and amphibian
- 1.2.24 Describe the life cycle of a frog
- 1.2.25 Distinguish between the skin of reptiles and amphibians
- 1.2.26 Relate the reproduction in reptiles to egg laying
- 1.2.27 Describe the function of feathers and air sacs for birds
- 1.2.28 Discuss the feet, wings and bills of birds as special adaptations
- 1.2.29 Describe the hibernation of one mammal
- 1.2.30 List the principal characteristics of mammals
- 1.2.31 Know the fish body systems and their dependence on each other
- 1.3.13 Know about the dangers of drug misuse
- 1.3.14 Know that the enzymes in saliva are the first to begin digestion of food

- 1.3.15 Trace the circulation of blood through the body
- 1.3.16 Know the main parts of a microscope and demonstrate proper skills in using the microscope
- 1.3.17 List the organs (and their functions) of the five senses
- 1.3.18 Know the three main parts of the brain and their major functions
- 1.3.19 Distinguish between dermis and epidermis
- 1.3.20 Know the parts of the blood
- 1.3.21 Know the function of arteries, veins and capillaries
- 1.3.22 Describe the difficulties of pre-adolescence
- 1.3.23 Describe how the reproductive system functions
- 1.3.24 Know the correct names of male and female reproductive organs
- 1.3.25 Know the function of digestion
- 1.3.26 List the major muscles of the body
- 1.3.27 Know the proper health care for teeth
- 1.3.28 Relate rest and sleep to health of the body
- 1.3.29 Relate proper diet to healthful living
- 1.3.30 Name and give examples of the four basic food groups
- 1.3.31 List the essential nutrients needed by the body
- 1.3.32 Know examples of food which contains essential nutrients
- 1.3.33 Know the various types of joints of the skeleton system
- 1.3.34 Know the glands of the endocrine system
- 1.3.35 Relate the effects of tobacco, alcohol and drugs on the human body
- 2.1.16 Identify fossilized rocks
- 2.1.17 Know that to conserve something means to use it wisely
- 2.2.9 Demonstrate the use of a balance scale to find the mass of an object
- 2.2.10 Discuss the condition of space travel as it relates to living condition
- 2.2.11 Describe the composition and location of the sun
- 2.2.12 Name and locate the planets
- 2.2.13 Know that formation of the earth coincides with Genesis, Chapter I
- 2.2.14 Describe how coal is formed
- 2.2.15 Know how petrified wood is formed
- 2.2.16 The moon
 - 2.2.16.1 Explain the rotation of the moon
 - 2.2.16.2 Describe the phases of the moon
 - 2.2.16.3 Know what causes a lunar eclipse
 - 2.2.16.4 Relate tides to the various positions of the moon and the earth
- 2.3.7 List the names of the various violent storms as they relate to the geography where they occur
- 2.3.8 Know the causes of severe weather such as tornadoes, hurricanes, hail, blizzards, sand storms, etc.
- 2.3.9 Identify the weather usually associated with each cloud formation
- 2.3.10 Know the properties of air and the behavior of various air (warm dry air, warm moist air, cool dry air, cool moist air, cold dry air, cold moist air, etc.)
- 2.3.11 Know that the earth's rotation breaks up the general circulation of the air between the poles and the equator
- 2.3.12 Know how the instruments used by meteorologists function
- 2.3.13 Know what causes rain, hail, snow, and sleet
- 2.4 List the causes and effects of pollution
- 3.1.10 Describe the conversion of nuclear energy to electrical energy in a nuclear power plant
- 3.1.11 Describe how heat causes objects to expand
- 3.1.12 Know how to read a thermometer
- 3.1.13 Understand the motion of molecules in gases, liquids and solids
- 3.1.14 Know various energies are transferred
- 3.1.15 Know how heat energy is used
- 3.1.16 Understand the principles of adhesion and cohesion
- 3.1.17 Know the law of conservation of energy
- 3.1.18 Describe the process of oxidation
- 3.1.19 Distinguish between fusion and fission
- 3.1.20 Describe the difference between potential energy and kinetic energy
- 3.3.8 Understand the term light year
- 3.3.9 Compare the parts of a camera to the parts of an eye
- 3.4.5 Know the difference between an open and a closed circuit
- 3.4.6 Understand the principle of how switches work - including feedback and thermostats
- 3.4.7 Know the function of a fuse
- 3.4.8 Understand how electricity is produced by generators
- 3.4.9 Know how electrical energy is produced from chemical energy and light energy
- 3.4.10 Understand what makes a material a conductor of electricity
- 3.4.11 Compare a series circuit with a parallel circuit
- 3.4.12 Know the relationship between electrons and electricity
- 3.4.13 Describe a galvanometer
- 3.4.14 Know the units of measure for electricity (ampere, watt, volt)
- 3.4.15 Know four scientists who have made significant contributions in the field of electricity
- 3.4.16 Understand that the earth functions as a huge magnet
- 3.4.17 Define the following terms: insulation, transformer, generator
- 3.5 Heat
 - 3.5.1 Describe how heat energy is transferred and give an example of each
 - 3.5.2 Explain how heat is measured

- 3.5.3 Differentiate between heat and temperature
- 3.5.4 Define the term calorie
- 3.6 Simple machines
 - 3.6.1 Name the simple machines
 - 3.6.2 Describe the uses of simple machines
- 4.0 METRICS
 - 4.1 know the seven basic units of the metric system
 - 4.2 Understand how to communicate measurements using the metric units

LEVEL SIX

- 1.1.14 Recognize that some plants can be reproduced by vegetative propagation
- 1.1.15 Understand hydroponics
- 1.1.16 Describe the life cycle of a flowering plant
- 1.1.17 Describe how seedless fruits are produced
- 1.1.18 Know how mutations are beneficial
- 1.1.19 Know the means man uses in controlling his environment to protect himself against disease, infection, etc.
- 1.1.20 Name four factors necessary for plant life
- 1.1.21 Describe the relationship of soil to plant production and man's consumption
- 1.1.22 Recognize that embryos remain dormant until conditions are right for germination
- 1.1.23 Describe other activities of leaves, essential for plant life, other than for photosynthesis
- 1.1.24 Collect various samples of leaves of flowering plants
- 1.2.9 Know the life cycle of an insect (complete and incomplete metamorphic)
- 1.2.10 Describe the honeybee as a social insect
- 1.2.11 Relate three animal behaviors prevalent in domestic animals
- 1.2.12 Distinguish between the lengths of the life span for two different animals
- 1.3.11 Identify the principle parts of the microscope
- 1.3.12 Demonstrate the correct use of the microscope
- 1.3.13 Recognize that a living thing is the product of its heredity and its environment
- 1.3.14 Know that the characteristics of living things are determined by a genetic code and that changes in the genetic code produce changes in living things
- 1.3.15 Know that tissues are formed from like cells
- 1.3.16 Recognize that cells also produce and excrete waste
- 1.3.17 Know that cells are "fed" from the blood stream of an animal
- 1.3.18 Know the history directly related to the development of the cell theory
- 1.3.19 Recognize that the genetic code information is contained in the DNA molecules
- 1.3.20 Identify the major parts of plant and animal cells and know their functions
- 1.3.21 Relate that an organism is the product of its heredity and its environment
- 1.3.22 Know how chromosomes function in the cell
- 1.3.23 Know the role of DNA and RNA in the cell
- 1.3.24 Understand the Watson-Crick model of the DNA molecule
- 1.4.14 List the parts of a neuron
- 1.4.15 Describe the reception, conversion and transmission of sound that enables man to hear
- 1.4.16 Know the parts of the eye and how they function to enable us to see
- 1.4.17 Know some of the scientists that made important contributions to the understanding of the human body and good health
- 1.4.18 Describe the main classes of food our bodies use
- 1.4.19 Name and relate two kinds of glands that have special functions in our bodies
- 1.4.20 Recognize the need for a balanced diet each day
- 1.4.21 Recognize the causes of major diseases
- 1.4.22 Know the harmful effects of smoking to the human body
- 1.4.23 Know the effects of misuse of drugs to the human body
- 1.4.24 Distinguish among cartilage, tendons, ligaments, and joints
- 1.4.25 Distinguish between voluntary and involuntary muscles
- 2.1.7 Discuss sediments, sand and gravel on the valley bottom of streams
- 2.1.8 Know the "make-up" of the Mississippi River and other state rivers
- 2.2.14 Demonstrate how to measure air pressure, temperature and relative humidity
- 2.2.15 Distinguish among the different forms of precipitation
- 2.2.16 Construct a weather station
- 2.3.11 List the number of moons, characteristics and nicknames of the planets of our solar system
- 2.3.12 Describe the seasons and explain why they happen
- 2.3.13 Know the first astronaut who orbited the earth, orbited the moon, and who stepped on the moon's surface
- 2.3.14 Know the significance of the most recent space mission
- 2.3.15 List the theories regarding the formation of the solar system
- 2.3.16 Distinguish between Ptolemy's geocentric theory and Copernicus' heliocentric theory
- 2.3.17 Know the contributions of Galileo, Ptolemy, Copernicus, Kepler, Newton, Lippershey, and Einstein to the field of astronomy
- 2.3.18 Know the "oddity" of Uranus' rotation
- 2.3.19 Distinguish between rotate and revolve
- 2.3.20 List the advantages of a radio telescope over a light telescope
- 2.3.21 Know the difference between a lunar eclipse and a solar eclipse

- 2.3.22 Define the term equinox
- 2.3.23 Know Newton's theory of universal gravitation
- 2.3.24 Locate our solar system in the Milky Way galaxy on a map
- 2.3.25 Know the origin of the names of the planets
- 2.3.26 Distinguish between planets and stars
- 2.3.27 Explain the advantages of star photography over stargazing
- 2.3.28 Define the terms: asteroids, meteors, comets, stars, moon, planets
- 2.3.29 Know the simple constellations

- 3.1.14 Know Newton's Laws of Motion
- 3.1.15 Distinguish between fusion and fission
- 3.1.16 Know the symbols of common elements
- 3.1.17 Know the formula for common compounds
- 3.1.20 Know how to locate the atomic weight and atomic number of elements
- 3.2.15 Distinguish among reflection, refraction and absorption of light
- 3.2.16 Explain how we are able to see colors
- 3.2.17 Describe how light rays behave when they strike convex and concave mirrors
- 3.2.18 Construct a simple "shoe box" spectroscope and demonstrate the use in study of the spectra in the sun
- 3.2.19 Know the three classes of musical instruments
- 3.2.20 Define the terms: refract, prism and spectrum
- 3.2.21 Explain why mirrors form images
- 3.2.22 Explain how a rainbow is formed
- 3.2.23 List the colors in a spectrum of white light
- 3.3.6 Demonstrate series and parallel circuits
- 3.3.7 Define the terms: ampere, volt, watt
- 3.3.8 Demonstrate the production of static electricity
- 3.3.9 Describe current electricity according to its behavior and uses
- 3.3.10 Know how radio and television programs are transmitted
- 3.3.11 Know the uses of electricity
- 3.3.12 Distinguish between conductors and non-conductors of electricity
- 3.3.13 Know the safety devices associated with electrical appliances
- 3.4.4 Calculate the efficiency of simple machines
- 3.4.5 Know that friction causes need for and increase in effort to accomplish work
- 3.5 Chemistry
 - 3.5.1 Know what happens when a material burns
 - 3.5.2 Prepare oxygen
 - 3.5.3 Separate dissolved substances by distillation
 - 3.5.4 Define the terms: solvent, solute, and solution
 - 3.5.5 Distinguish between soluble and insoluble substances
 - 3.5.6 Describe how carbon dioxide is prepared
 - 3.5.7 Define the terms: base, salts and acids
 - 3.5.8 Test substances to determine the presence of sugars, starches, fats, and proteins

- 4.0 Metric System
 - 4.1 Know the basic units of the metric system

GENERAL SCIENCE (LEVEL SEVEN)

- 2.1.3 Name three types of bacteria
- 2.1.4 Name three shapes of bacteria
- 2.1.5 Name two diseases caused by bacteria
- 2.1.6 Name five protozoans
- 2.1.7 Draw and label five protozoans
- 2.1.8 Explain patterns of locomotion in protozoa
- 2.1.9 Name and define parts of typical protozoan bodies
- 2.1.10 Distinguish protozoa from metazoa
- 2.2.3.3.3 Distinguish between soft woods and hard woods
- 2.2.4 Photosynthesis
 - 2.2.4.1 Describe the process of photosynthesis
 - 2.2.4.2 Describe the light and dark phase of photosynthesis
- 2.2.5 Name and define parts of a typical flower
- 2.2.6 Define types of pollination
- 2.2.7 Draw and label a typical flower
- 2.3.2.4 Identify several insects such as butterflies, moths, grasshoppers, crickets, mosquito, wasp, etc.
- 2.3.2.5 Know the general characteristics of Mollusks, Annelids and Arthropods and give examples of each
- 2.3.2.6 Name and give the characteristics (in general) of the phyla Protozoa, Porifera, Coelenterata, Platyhelminthes, Nematelminthes, and Echinodermata - give at least one example of each phylum
- 2.3.3.5.3 Know five general characteristics of the class Aves
- 2.3.3.5.4 State one example of birds having a harmful effect on man
- 2.3.3.6.2.6.3 Define venereal disease and method of transmittance
- 2.3.3.6.2.6.4 Explain process and function of menstruation
- 2.3.3.6.2.8.3 Know the main groups of food and their contribution to a balanced diet

- 2.3.3.6.2.8.4 List five major diseases and their causes
- 2.3.3.6.2.8.5 Define deficiency disease (explain how diet deficiencies can cause diseases)
- 2.3.3.6.2.8.6 List common deficiency diseases and give the cause of each disease
- 2.3.3.6.2.9 Describe the basic function of the central nervous system and the peripheral nervous system
- 2.3.3.6.2.10 Skeleton system
 - 2.3.3.6.2.10.1 Describe function of skeletal system
 - 2.3.3.6.2.10.2 Name thirty of the main bones of the human body
- 2.3.3.6.2.11 Name the five senses and relate their importance to life
- 2.3.3.6.2.12 Genetics and heredity
 - 2.3.3.6.2.12.1 Know the principal laws related to genetic theory and heredity
 - 2.3.3.6.2.12.2 Define: chromosomes, genes, fertilization, hybridation, dehybrid, dominance
 - 2.3.3.6.2.12.3 State Mendel's Laws
 - 2.3.3.6.2.12.4 Describe mitosis
 - 2.3.3.6.2.12.5 Name the phases in cell division and steps in each
 - 2.3.3.6.2.12.6 Know the difference between mitosis and meiosis
- 2.4 Animal and plant parasites
 - 2.4.1 Name two animal parasites
 - 2.4.2 Trace the life cycle of two animal parasites
 - 2.4.3 Draw and label two animal parasites
 - 2.4.4 Name animals that act as hosts for animal parasites
 - 2.4.5 Name two plant parasites
 - 2.4.6 Trace the life cycle of two plant parasites
 - 2.4.7 Name plants that act as hosts for parasites

3.5 Explain the formation of plant communities

LIFE SCIENCE (LEVEL SEVEN)

- 3.1.1.5 Know the scientific name for man
- 12.2.1.4 Compare the Kelvin Scale with the Fahrenheit Scale on a thermometer

GENERAL SCIENCE (LEVEL EIGHT)

- 1.2.3 Describe various life functions carried on by the cell
- 1.2.4 Explain how certain substances are able to pass through a cell membrane by the process of osmosis
- 1.2.5 Explain the process of cell division (mitosis)
- 2.1.3 Explain why the waste products of bacteria (toxins) are harmful to body cells
- 2.1.4 Compare viruses and bacteria
 - 2.2.1.4 Describe the process of chemosynthesis
 - 2.2.2.4 Describe the process of photosynthesis and explain its importance to the energy cycle
 - 2.2.2.5 Explain how simple green plants are related to the world's food supply
 - 2.2.3.1.3 Name three general types of spore bearing plants
 - 2.2.3.2.4 Describe the structure of flowering plants
 - 2.3.1.4 Describe the three main divisions of the body of an insect
 - 2.3.1.5 List and explain the stages of metamorphosis
 - 2.3.1.6 List three ways in which insects are beneficial and three ways in which insects are harmful as related to man
 - 2.3.2.4 List one advantage and one disadvantage of an endoskeleton
 - 2.3.3.1.5 Explain how fishes obtain oxygen from water
 - 2.3.3.1.6 Discuss the economic importance of fish
 - 2.3.3.5.3.13 Name the types of muscles in the body
 - 2.3.3.5.3.14 Explain the function of the muscular system
 - 2.3.3.5.3.15 Describe functionally the reproduction system of humans
 - 2.3.3.5.3.16 Compare the reproduction of simple vertebrates to more complex vertebrates
 - 2.3.3.5.3.17 Know the major bones of the body
 - 2.3.3.5.3.18 Name some diseases common to man
 - 2.3.3.5.3.19 Define blood pressure in relation to diastolic and systolic pressure
- 4.1.1.11 Describe three different types of rocks giving their distinguishing characteristics, such as, composition and texture
- 4.1.1.12 Describe the processes of erosion and weathering in relation to land formation
- 4.1.1.13 Explain the processes of diastrophism and volcanism and their part in changing the earth's crust
- 4.1.1.14 Explain the causes of earthquakes
- 4.2.7 List some of the natural resources found in the world's oceans
- 4.2.8 Explain the meaning of ground water
- 4.2.9 Describe the water cycle and relate its importance to life
- 4.3.9 Describe the various forms and causes of precipitation
- 4.3.10 Describe the effect of water on land formation and glaciers
- 4.3.11 Describe the composition of the atmosphere

- 4.3.12 Describe the different layers which make up the atmosphere
- 4.3.13 Explain the relationship between climate and weather
- 5.1.6 Describe some distinguishing characteristics of each planet in our solar system
- 5.1.7 Describe the effects of the earth's rotation
- 5.1.8 Explain the reasons for the earth's changing seasons
- 5.1.9 List the planets starting with the one closest to the sun and proceeding to the one farthest from the sun
- 5.1.10 Give the number of satellites (moons) for each planet in our solar system
- 5.2.5 Describe the position in space and a possible explanation of origin for asteroids
- 5.2.6 Explain the difference between meteors and meteorites
- 5.2.7 List the various rays and particles radiating from the sun which are received by the earth
- 5.2.8 Describe the composition of various layers which make up the sun
- 5.2.9 Explain the star cycle
- 5.3.3 Be able to locate four constellations in the sky
- 5.3.4 Describe means (radio waves and visible light) by which man can observe the universe
- 5.3.5 Explain the method of measuring celestial movement by the method of parallax
- 5.5 Describe theories of the formation of the solar system
- 6.5 Know the types of galaxies
- 6.6 Explain man's need to explore in space
- 7.1.6 Describe the four basic forms of matter
- 7.1.7 Define matter
- 7.3.6 Explain the law of Conservation of Matter

EARTH AND SPACE SCIENCE (LEVEL EIGHT)

- 1.1.5 Describe changes in matter--physical, chemical and nuclear
- 1.2.10 Display a rock collection indigenous to local rocks
- 1.2.11 Distinguish among rocks, minerals, gems (precious and semi-precious), and ores
- 1.2.12 Explain what is meant by a fault
- 1.2.13 Locate major faults on a map of the world
- 1.2.14 Describe the principal upon which a seismograph works
- 1.2.15 Identify the types of seismic waves
- 1.2.16 Topographic maps
 - 1.2.16.1 Draw symbols commonly used on topographic maps
 - 1.2.16.2 Interpreting land forms on topographic maps as shorelines, valleys, deltas, etc.
- 1.2.17 Name the two most abundant rocks of the earth's crust and their component minerals
- 1.3.7 Describe the evolution of life from the "cosmic dust" to modern animals (life from water to land)
- 1.3.8 Describe the evolution of man
- 1.3.9 Describe different conditions during the different periods and eras
- 1.3.10 Discuss the characteristics of the following eras: Cenozoic, Mesozoic, Paleozoic, Precambrian
- 1.4.7 Describe how soil is formed
- 1.4.8 Collect soil samples from various types of soil
- 2.3.7 Describe the formation of a levee and a sand bar
- 2.3.8 The Mississippi River's drainage pattern
 - 2.3.8.1 Identify the tributaries and distributaries of the Mississippi River
 - 2.3.8.2 Identify the Mississippi River delta
 - 2.3.8.3 Tell how snow in the northern United States can cause flooding in the southern states
 - 2.3.8.4 Describe the importance of the Mississippi River
- 2.4.5 Name and locate on a map the oceans of the world
- 3.2.13 Describe on a map the major global wind patterns (i.e., doldrums, horse latitudes, jet stream, etc.)
- 3.2.14 Identify continental and maritime air masses
- 3.2.15 Diagram currents associated with a land breeze and a sea breeze
- 3.2.16 Demonstrate ability to read a weather map from a newspaper
- 3.2.17 Identify the function of the following instruments: thermometer, hygrometer, barometer
- 3.2.18 Identify the following terms: humidity, barometric pressure, dew point, meteorology
- 3.3.2 Construct charts showing different types of air pollution
- 4.1.2 Explain early beliefs of the constellations and solar system (i.e., celestial sphere)
- 4.2.3 Explain the motion of our galaxy
- 4.3.4.1.7 Describe the effect of solar flares, solar prominences, sunspots, and solar winds upon the weather, radio and television transmissions and the aurora borealis
- 4.3.5 Identify the circumpolar stars (constellations) and explain why they are called circumpolar
- 4.3.6 Explain why some constellations are "winter constellations and others are fall, spring, or summer constellations"
- 4.3.7 The origin and evolution of a star
 - 4.3.7.1 Construct a Hertzsprung-Russell diagram
 - 4.3.7.2 Identify different stars in different evolutionary stages

- 4.3.8 Observe the motions of the stars and explain why the stars rise and set once more annually than the sun
- 4.3.9 Diagram the electromagnetic spectrum
- 4.3.10 Using stellar spectrum strips identify different characteristics of stars (i.e., temperature, elements present, Doppler effect--red and blue shift)
- 4.3.11 Explain cosmic radiation
- 4.3.12 Explain some of the myths behind Ursa Major, Ursa Minor, and Orion
- 4.3.13 Identify three constellations in the night sky
- 4.4.5 Explain the motions of our planet
- 4.4.6 Universal motion
 - 4.4.6.1 Explain earth's motions
 - 4.4.6.2 Describe the moon's motions in relation to the earth
 - 4.4.6.3 Illustrate the motion of the earth and its satellite in relation to the sun
 - 4.4.6.4 Describe the motion of the solar system
 - 4.4.6.5 Compare and contrast the motion of stars and galaxies
- 4.5.3 The moon's phases and motions
 - 4.5.3.1 Describe the moon's motions--rotation and revolution
 - 4.5.3.2 Diagram the eclipses of the moon and the sun
 - 4.5.3.3 Explain why there is not an eclipse every month
 - 4.5.3.4 Explain the correlation between the motion of moon and the development of different types of calendars and also sidereal month and synodic month
- 4.5.4 Describe different theories for the origin of the moon
- 4.5.5 Explain how the moon affects our planet
- 4.5.6 Diagram the earth, sun and moon to show the positions of each for each phase as we see it from earth
- 4.5.7 Explain how the earth could be a satellite
- 4.6.3 Compare the probable origins and composition of comets, meteors, and asteroids
- 4.7.7 Motions of the earth
 - 4.7.7.1 Describe the seasons of the earth by using a diagram
 - 4.7.7.2 Identify positions on the earth using longitude and latitude
 - 4.7.7.3 Tell time around the world using time zones (also dates)
 - 4.7.7.4 Demonstrate ability to read a topographic map
- 4.7.8 Know the universal law of gravitation
- 4.7.9 Discuss development of latitude, longitude, grid system roundness, and flattening of the earth
- 4.8 Earthquakes
 - 4.8.1 Define earthquakes
 - 4.8.2 List the causes of earthquakes
 - 4.8.3 List the effects of earthquakes
 - 4.8.4 Describe the location of earthquakes
 - 4.8.5 Explain the prediction of earthquakes
- 4.9 Volcanoes
 - 4.9.1 Describe how volcanoes are formed
 - 4.9.2 Identify the products of volcanic eruption
 - 4.9.3 List the kinds of volcanoes
 - 4.9.4 Name where volcanoes are found
 - 4.9.5 List the benefits of volcanoes
 - 4.9.6 Discuss several famous volcanic eruptions
- 5.0 Space Science
 - 5.1 Rockets
 - 5.1.1 Explain the basic components of rocket engines
 - 5.1.2 Explain the principal of the multistage rocket
 - 5.1.3 Explain orbits and discuss circular and elliptical orbits
 - 5.1.4 Explain escape velocity
 - 5.1.5 Explain why rocket engines are able to function in space where there is no air and "nothing to push against"
 - 5.2 Space investigation and exploration
 - 5.2.1 Relate the significance of the discoveries of the following: Kepler, Copernicus, Ptolemy, Brahe, Galileo, Newton
 - 5.2.2 Explain the function of the following instruments: reflecting telescope, refracting telescope, radio telescope, spectroscope, sextant, quadrant
 - 5.2.3 Discuss the accomplishments of such men as Goddard, Glenn, Armstrong, von Braun, and Shepherd
 - 5.2.4 Relate the purposes and accomplishments of the following space programs: Explorer, Vanguard, Discoverer, Pioneer, Mercury, Range, Telstar, Surveyor, Gemini, Mariner, Apollo, and Skylab
 - 5.3 Space travel
 - 5.3.1 Explain the biological and physical problems involved in space travel
 - 5.3.2 Explain the procedures and major obstacles connected with travel to the moon and other members of solar system
 - 5.3.3 Explain the basic principals governing the operation of the rocket engine
- 6.0 Energy from the earth's matter
 - 6.1 Energy from matter in motion
 - 6.1.1 Explain energy at rest and energy in motion
 - 6.1.2 List and explain the sources of energy--chemical, electrical and nuclear

- 6.1.3 Demonstrate some ways of releasing energy
- 6.1.4 Explain how energy is used to do work
- 6.1.5 Explain how man has harnessed the natural forces of wind and water
- 6.2 Beginnings of chemistry
 - 6.2.1 Know symbols of common elements
 - 6.2.2 Explain growth of chemistry as a science
 - 6.2.3 Understand the major parts of the periodic chart
- 7.0 Ecology
 - 7.1 The physical environment
 - 7.1.1 Explain why water is essential to life
 - 7.1.2 Define optimum temperature
 - 7.1.3 Explain what is meant by limits of tolerance
 - 7.2 The biological environment
 - 7.2.1 Discuss ways in which man affects other species
 - 7.2.2 Describe habitats of different organisms
 - 7.2.3 Explain how two organisms in the same area can have separate ecological niches
 - 7.2.4 Describe a typical food chain
 - 7.3 Populations and communities
 - 7.3.1 Define a biotic community
 - 7.3.2 Describe what is meant by balance of nature
 - 7.3.3 Point out stages in ecological succession in the local area
 - 7.3.4 Construct a community (i.e., salt water, deserts, etc.)
 - 7.4 Man and his environment
 - 7.4.1 Explain how overpopulation is the principle cause of environmental pollution
 - 7.4.2 Describe several methods of population control (both positive and negative methods-- i.e., birth control, war, abortion, etc.)
 - 7.4.3 Identify sources of local air and water pollution
 - 7.4.4 Find a solution to an ecological problem and carry out this solution (i.e., clean up campaign, bottle drive, etc.)
 - 7.4.5 Explain how man is the cause and has caused the extinction of some species of wildlife
 - 7.4.6 Explain how man is capable of causing his own species to become extinct
 - 7.4.7 Describe the progression of a rural farm type community to a large metropolitan area

GENERAL SCIENCE (LEVEL NINE)

- 1.1.9 Name two differences between typical plant and animal cells
- 1.2.4.7 Know why bacteria is considered a protist
- 1.2.5.6.13 Identify by a scientific name twenty vascular woody plants
- 1.2.6.7.19.7 Know the types of foods most needed by the body
- 1.2.6.7.20 Man
 - 1.2.6.7.20.1 Know the parts of the human reproductive system
 - 1.2.6.7.20.2 Understand the menstrual cycle
 - 1.2.6.7.20.3 Understand the effects of the hormones involved in the reproductive system on emotions
 - 1.2.6.7.20.4 Know how venereal diseases are spread, their symptoms, and treatment
 - 1.2.6.7.20.5 Understand the process of reproduction in humans
 - 1.2.6.7.20.6 Understand basic concepts of genetics
 - 1.2.6.7.20.7 Discuss knowledge of contraception
 - 1.2.6.7.20.8 Name ten systems of the human body
- 1.2.6.8 Know two differences between arachnids and insects
- 1.2.6.9 Name five classes of vertebrate animals and give an example of each
- 1.3.5 Explain the relationship of the science of ecology to the balance in nature
- 1.3.6 Demonstrate H_2 - H_2O contamination
- 2.2.4 Compare the metric measurements of a block of wood in length, weight, and volume to the English system
- 2.3.8 Describe the structure of molecules
- 2.3.9 Explain the structure of atoms
- 2.3.10 Explain the formation of isotopes
- 2.3.11 Discuss valence as basis for covalent and ionic bonding
- 2.3.12 Know the difference between a symbol and a formula
- 2.3.13 Define a compound
- 2.3.14 Chemistry of carbon
 - 2.3.14.1 Know the properties of carbon atom
 - 2.3.14.2 Know processes of separating mixtures of carbon compounds
 - 2.3.14.3 Explain how carbon forms compounds
 - 2.3.14.4 Describe how to synthesize molecular chains
- 2.4.5 Explain the relationship between energy and matter
- 2.4.6 Explain how the principle of the conservation of matter and energy has changed
- 2.4.7 Compare the pros and cons of nuclear energy vs. conventional energy

- 3.1.5 Explain how sound vibrations or waves may be carried on radio or electromagnetic waves
- 3.1.6 Explain the production and transmittance of sound waves
- 3.1.7 Identify different types of musical instruments as related to method of sound production
- 3.1.8 Distinguish between music and noise
- 3.1.9 Compare various forms of transmitting mediums
- 3.1.10 Describe the Doppler effect
- 3.1.11 Diagram the ear and explain function of each part
- 3.2.6 Explain the electromagnetic spectrum
- 3.2.7 Explain the relationship of temperature and heat
- 3.2.8 Explain the change of liquid to gas
- 3.3.12 Demonstrate how hydroelectric plants operate
- 3.3.13 Demonstrate how steam-generating plants operate
- 3.3.14 Explain thermocouple
- 3.3.15 Know the theory of ions and describe their properties
- 3.3.16 Describe electrolytes and nonelectrolytes
- 3.3.17 Compare communicating with wires and communicating with waves
- 3.4 Mechanical energy
 - 3.4.1 Solve problems using work and power formula
 - 3.4.2 Define: work, power, energy
 - 3.4.3 Define a simple machine
 - 3.4.4 Define power trains
- 3.5 Heat energy
 - 3.5.1 Explain heat expansion
 - 3.5.2 Explain how heat is transferred and measured
- 3.6 Light energy
 - 3.6.1 Explain the speed of light
 - 3.6.2 Distinguish between types of optical instruments
 - 3.6.3 Explain whether light is a wave or particle
 - 3.6.4 Explain the color concept
- 3.7 Nuclear energy
 - 3.7.1 Discuss matter and energy within the atom
 - 3.7.2 Discuss energy production in nuclear power plants
 - 3.7.3 Explore the concept of nuclei with atomic bullets
- 3.8 Atmospheric pressure
 - 3.8.1 Explain atmospheric pressure
 - 3.8.2 Relate use of atmospheric pressure
 - 3.8.3 Know Boyle's Law
- 4.1.5 Name three simple machines
- 4.1.6 Describe forces in solids and liquids
- 4.2.8 Name and explain the differences among the types of engines
- 5.1.12 Distinguish between weathering and erosion
- 5.1.13 Describe means of physical and chemical weathering
- 5.1.14 Identify the role of water in weathering and erosion
- 5.1.15 Relate earthquakes and relationship to lithosphere formations
- 5.1.16 Identify "ring of fire"
- 5.2.1.1 Describe the topography of the ocean floor: shelves, slopes, trenches, ridges
- 5.2.1.5 Identify salinity; composition of sea water
- 5.2.1.6 Relate the economic importance of the sea and its minerals, etc.
- 5.2.1.7 Name and identify contribution of Timothy Folger, Benjamin Franklin, Matthew Maury, and H. M. S. Challenger to science
- 5.2.1.8 Distinguish between tides, waves and currents
- 5.3.9 Describe the cause of the prevailing winds
- 5.3.10 Explain how hurricanes originate
- 6.7.4 Explain Greenwich mean time
- 6.8.4 Discuss methods man might use to solve his space travel problems
- 6.8.5 Locate the north star
- 6.8.6 Explain why the position of the north star does not change and can therefore be used in determining directions
- 7.0 Ecological Relationships
 - 7.1 The habitat
 - 7.1.1 Explain the limiting factors in a habitat
 - 7.1.2 Name four physical factors influencing the habitat
 - 7.1.3 Draw and discuss a food pyramid
 - 7.1.4 Define symbiosis, parasitism, mutualism, and commensalism
 - 7.1.5 Name three ways of passive protection an animal uses
 - 7.2 Ecological cycles
 - 7.2.1 Discuss the water cycle
 - 7.2.2 Discuss the carbon oxygen cycle
 - 7.2.3 Discuss nitrogen cycle

- 7.3 Periodic changes in environment
 - 7.3.1 Name three diurnal animals
 - 7.3.2 Name three nocturnal animals
 - 7.3.3 Tell the difference between hibernation, estivation, and migration
- 7.4 Biogeography
 - 7.4.1 Define flora and fauna
 - 7.4.2 Name the major barriers of animal and plant dispersal
 - 7.4.3 Know the difference between coniferous and deciduous forests
 - 7.4.4 Know the difference between a fresh water biome and a marine biome
- 7.5 Soil and water conservation
 - 7.5.1 Name the layers of soil
 - 7.5.2 Name three ways to prevent erosion and wearing away of the soil
 - 7.5.3 Name two ways we conserve water
- 7.6 Forest and wildlife resources
 - 7.6.1 Discuss the balance of nature
 - 7.6.2 Name some causes of forest being destroyed
 - 7.6.3 Know how we are compensating for the loss of our forests
 - 7.6.4 Describe wildlife conservation and how do we provide for it
 - 7.6.5 Name benefits national parks and forests offer
- 8.0 Scientific Method
 - 8.1 Know the steps of the Scientific Method
 - 8.2 Apply the Scientific Method to a problem
 - 8.3 Relate the Scientific Method to daily experiences
- 9.0 Metric System
 - 9.1 Demonstrate conversion within metric units
 - 9.2 Demonstrate conversion of metric units to English units
 - 9.3 Demonstrate conversion of English units to metric units

PHYSICAL SCIENCE (LEVEL NINE)

- 2.1.1.6 Measure the density of a gas, a liquid, and a solid in metric units
- 2.1.2.4 Demonstrate a method of determining volume of a different substance
- 2.4.2.8 Demonstrate proficiency in balancing simple, compound, single replacement and double replacement chemical reactions
- 2.4.3 Nuclear change
 - 2.4.3.1 Explain what is meant by a nuclear change
 - 2.4.3.2 Explain some of the properties of a nuclear change
 - 2.4.3.3 Compare a nuclear change to that of a physical or chemical change
- 3.2.1.6.4 Explain the effect of temperature on solids and liquids
- 5.0 Earth Science
 - 5.1 The universe
 - 5.1.1 List the planets in order from the sun outward
 - 5.1.2 Explain galaxy, solar system, satellites, etc.
 - 5.1.2.1 List three types of galaxies
 - 5.1.2.2 Explain nebula and give examples
 - 5.1.3 Explain magnitudes and types and give examples
 - 5.2 The earth
 - 5.2.1 Discuss the structure of the earth
 - 5.2.2 Name layers of the earth
 - 5.2.3 List the three layers of earth's crust
 - 5.3 Geology
 - 5.3.1 Discuss rocks and their composition
 - 5.3.2 List the three types of rocks and the characteristics of each
 - 5.3.3 Discuss the rock cycle
 - 5.4 Conservation of natural resources
 - 5.4.1 Soil and water conservation
 - 5.4.1.1 Soil origin and types
 - 5.4.1.1.1 Define soil
 - 5.4.1.1.2 Explain role of the forces of weathering in the breaking of rock into soil
 - 5.4.1.1.3 Describe properties of three classes of soil
 - 5.4.1.1.4 Define humus
 - 5.4.1.1.5 Give importance of humus to soil
 - 5.4.1.1.6 Distinguish between residual and transported soils
 - 5.4.1.2 Erosion - movement of soil
 - 5.4.1.2.1 Define erosion
 - 5.4.1.2.2 Describe two forces that cause erosion

- 5.4.1.2.3 Discuss running water as a major cause of soil erosion
- 5.4.1.2.4 Discuss problems resulting from erosion - washing away of topsoil, gully formation, leaching of chemicals resulting in loss of soil fertility and blockage of drainage systems
- 5.4.1.3 Water and related problems
 - 5.4.1.3.1 Review water cycle and relate it to water conservation
 - 5.4.1.3.2 Define watershed
 - 5.4.1.3.3 Diagram drainage system of a river
 - 5.4.1.3.4 Discuss problems of flooding, back water, and drought
 - 5.4.1.3.5 Explain close relationship between soil erosion and flooding by streams
- 5.5 Coal formation
 - 5.5.1 Types of coal
 - 5.5.1.1 Define lignite
 - 5.5.1.2 Define bituminous coal
 - 5.5.1.3 Define anthracite coal
- 5.6 The atmosphere
 - 5.6.1 Name the three types of atmosphere
 - 5.6.2 Weather
 - 5.6.2.1 Define thunderstorms
 - 5.6.2.2 Define tornado
 - 5.6.2.3 Define waterspout
 - 5.6.2.4 Define hurricane
 - 5.6.3 Air masses
 - 5.6.3.1 Name the four types of air masses
 - 5.6.3.2 Name the types of clouds in air masses

BIOLOGY

- 1.1.3.5 Know how to properly care for the microscope (handling, storage, etc.)
- 1.1.4.3 Define the technical method of investigation
- 1.1.4.4 Define the research method of investigation
- 1.2.3.5 Distinguish between abiogenesis and biogenesis
- 1.2.4.1 List eleven processes which characterize life and explain each
- 1.2.5.3 List several kinds of plants and animals that are endangered species and measures being used to save them
- 1.2.5.4 List several kinds of plants and animals that have become extinct
- 1.2.6 In the beginning
 - 1.2.6.1 Describe the theory of chemical evolution
 - 1.2.6.2 Distinguish between living and nonliving
 - 1.2.6.3 Define spontaneous generation
 - 1.2.6.4 Give an overview of evolution of life on earth
- 1.3.1.5 Explain the mechanism of digestion
- 1.3.1.6 Contrast digestion in simple and complex organisms
- 1.3.3.3 Illustrate chemical change in matter by using the burning of wood
- 1.3.5.4 Know the number of man-made elements
- 1.3.5.5 Know the symbols of common elements
- 1.3.5.6 Know the names of the first twenty elements and related information
- 1.3.5.7 Know how to determine the atomic number of an element
- 1.3.7.2 Know the atomic number and atomic mass of the common elements
- 1.3.11.3 Demonstrate by use of models how compounds are formed
- 1.3.12.2 List physical and chemical properties of the elements
- 1.3.18.5 Define lipid
- 1.3.19.10 Define protein
- 1.3.20.5 Understand that enzymes are specific
 - 1.3.21.2.9 Explain how nucleotides are put together to form a DNA molecule
- 1.4.3.2.6 Make a labeled drawing of an animal cell
- 1.4.4.3.2.1 Name two major differences between plant and animal cells
- 1.4.4.3.3.5 Make a labeled drawing of a plant cell
- 1.4.4.4 List structural differences between plant and animal cells
- 1.4.7 Define the terms unicellular, colonial, and multicellular
- 1.5.2.3 List and distinguish among the five theories of plasma membrane permeability as stated by Guyton
- 1.5.3.4 Compare the rate of diffusion of solids, liquids, and gases and explain differences
- 1.5.3.5 Demonstrate the affects of isotonic, hypertonic, and hypotonic solutions on cells
- 1.5.3.6 Demonstrate and explain active transport and passive transport through the cell membrane
- 1.5.4.3 Show semipermeable properties of an egg membrane
- 1.5.6 Describe in detail at least one active transport system
- 1.6.1.3.10 Explain how temperature, water, minerals and genetical factors influence the rate of photosynthesis
- 1.6.1.6.2.9 Write and balance the equation for respiration; show contrast with photosynthesis
- 1.7.3.10 Describe a test for protein
- 1.7.3.11 Name and give the symbols for the elements in protein
- 1.7.4.2.4 Make a chart comparing the end products and energy quantities released in aerobic and anaerobic respiration

- 1.8.1.5 Define a mother cell
- 1.8.3.5 Discuss the role of meiosis in spore formation and zygote germination
- 1.8.3.6 Distinguish between meiotic and mitotic cell divisions
- 2.1.1.7 Define incomplete dominance and show how incomplete dominance is an exception to the principle of dominance and recessiveness
- 2.1.1.8 Define these terms: diploid, haploid, polyploid, monohybrid, dihybrid, dominant, recessive, genotypes, phenotypes, heterozygous, homozygous, test cross
- 2.2.20 Explain how adaptation to the sun can take place
- 2.3.2.7 Define species
- 3.4.2.2.6 Diagram the structure of an Ameba
- 3.4.3.2.4 Make a labeled drawing of a Paramecium
- 3.4.4.1.7 Diagram the structure of an Euglena
- 4.7.1.3 Explain the terms xerophytes, mesophytes, and hydrophytes
- 4.7.10 Transpiration
 - 4.7.10.1 Define transpiration
 - 4.7.10.2 Relate the effect of transpiration on plants
 - 4.7.10.3 List four environmental factors that determine the rate of transpiration
 - 4.7.10.4 List three physiological factors that determine the rate of transpiration
- 4.8.1.1.6 Illustrate plant photoperiodism with and without growth hormones
- 5.1.1.3 Explain how multicellular conditions lead to interdependence of cells
- 5.2.1.5 Describe the planula larva
- 5.3.8.5 Know the relationship of ducks and liver flukes in the pig
- 5.3.9.10 Explain why fish bear tapeworm scars
- 5.4.8.8 Describe how the hookworm enters the bodies of men and animals
- 5.4.8.9 Trace the path followed by a hookworm through the body, human and dog, by naming all structures through which it passes
- 5.4.8.10 List two means of preventing hookworm disease in both animal and man
- 5.4.8.11 Make a list of clinical and common signs of hookworm infestation in animals (dogs)
- 5.4.10.1 List at least three kinds of nematodes which are parasitic in plants
- 5.5.1.13 Trace a particle of food through the digestive system of the earthworm, naming the organs through which it passes
- 5.6.5.9 Describe the trochophore larva
- 5.6.9 Discuss the economic importance of mollusks
- 5.7.5.8 Summarize the phylogentic tree
- 6.2.7 Explain how sight from each eye of the fish go to different parts of the brain
- 6.3.2.3.3 Draw a labeled diagram of the life history of the frog from egg to adult
- 6.3.2.3.4 Write a summary of the changes that occur as the tadpole develops into a frog - emphasize the changes from a tadpole that must live in water to a frog that can live on land
- 6.3.2.3.5 The frog - a representative amphibian
 - 6.3.2.3.5.1 External structures of the frog
 - 6.3.2.3.5.1.1 Label a drawing of the external structures of the frog
 - 6.3.2.3.5.1.2 Describe the skin, head, and legs of the frog
 - 6.3.2.3.5.2 Internal anatomy of the frog
 - 6.3.2.3.5.2.1 Name the structures in the mouth and describe the close relationship between structure and function in croaking, capturing food, and in passing food to the stomach and air to the lungs
 - 6.3.2.3.5.2.2 Make an outline showing the organs that make up the following systems: digestive system, respiratory system, circulatory system, nervous system, excretory system, and reproductive system
 - 6.3.2.3.5.2.3 Label diagrams of the previous systems of the frog
- 6.3.2.3.6 Know three ways in which frogs are of economic importance to man
- 6.4.4.6.7 Know the difference between venom and poison
- 6.4.4.6.8 Describe how to care for a person or animal bitten by a poisonous snake
- 7.1.4.5 List the three human races and their physical characteristics
- 7.3.2.1.4.4 Define jaundice and list some causes
- 7.3.2.2.2.3 Describe the condition of diverticulosis
- 7.4.1.4.7 Explain why the white blood cell count increases in some illnesses
- 7.4.1.6.4 Describe how the blood types are different and explain why blood of different types can not be mixed
- 7.5.1.4 Know the length of filter tubes in a normal kidney
- 7.6.1.1.5 Describe a hiatal hernia
- 7.7.2.3 Describe the role of chlorine and antichlorine in the synapse
- 7.7.6.2.3 Diagram the location of the four different types of taste receptors on the tongue
- 7.7.6.5.8 Describe the early symptoms of glaucoma
- 7.9.3.9 Describe how to test for glucose
- 7.10.2.1.5 Define varicocele
- 7.10.2.1.4 Describe the effect on sperm cells if retained continuously at body temperature

- 7.10.2.1.5 Discuss the effect that high frequency transmission can have on the sterility of the male
- 7.10.3.8 Describe the placenta
- 7.10.4 Venereal disease
 - 7.10.4.1 Define syphilis
 - 7.10.4.2 Define gonorrhea
- 7.10.5 Birth control and methods
 - 7.10.5.1 Describe chemical methods of birth control
 - 7.10.5.2 Describe the condom as a method of birth control
 - 7.10.5.3 Describe the diaphragm as a method of birth control
 - 7.10.5.4 Describe a douche as a method of birth control
 - 7.10.5.5 Describe the intrauterine device as a method of birth control
 - 7.10.5.6 Describe the pill as a method of birth control
 - 7.10.5.7 List reasons why birth control methods are needed and which are the most effective
- 8.1.5.3 Distinguish between normal populations and endangered populations and normal population density and endangered population densities
- 8.1.6.4 Define the term species and endangered species
- 8.2.5.2.5 Explain why 80 percent of food eaten by fish is microscopic
- 8.5.2.2.7 Explain process for the control of fire ants

MARINE BIOLOGY

No additional competencies were contributed.

EARTH AND SPACE SCIENCE (HIGH SCHOOL)

No additional competencies were contributed.

ADVANCED PHYSICAL SCIENCE

- 3.3.3 Photography
 - 3.3.3.1 Understand the chemistry of processing film
 - 3.3.3.2 Understand the chemistry of making prints
- 4.2.3 Define vulcanism
- 4.2.5.5 Discuss the future sources of energy such as the sun, oceans, and nuclei of the atom
- 6.3.1.3 Describe three methods of heat transfer
- 7.1.2.3.1 Recognize levers in common tools
- 11.2.2.2.1 Describe a nuclear power plant as the future source of power

CHEMISTRY

- 1.1.6 Demonstrate efficiency of working with metric units
- 1.1.7 Identify sources of error in measurement (human error and uncertainty of the measuring instrument)
- 1.1.8 Compute problems using the slide rule
- 1.1.9 State the law of conservation of matter and its application
- 1.1.10 State the law of conservation of matter and energy and its application [$E = mc^2$]
- 1.1.11 Understand exponential notation and significant figures
- 1.1.12 Determine the densities of materials
- 1.2.6 Describe the transuranic elements
- 1.3.6 Discuss the discovery of the electron and proton
- 1.3.7 Describe or discuss the work of Bohr, Rutherford, and Schrodinger
- 1.3.8 List standard notation for four Quantum numbers, meaning of each Quantum number, and the numerical values associated with each
- 1.3.9 Give four Quantum numbers of the last electron of selected numbers of representative elements
- 1.3.10 Given four Quantum numbers of the last electron of an element, identify the element
- 1.3.11 Use atomic structures to show how atoms are bonded to form substances
- 3.1.6 Describe ionic, covalent, and coordinate covalent chemical bonding
- 3.1.7 Use electronegativity values to predict bond types
- 3.2.7 Explain entropy in connection with reaction tendencies
- 3.3.6 Calculate pH of acid solutions
- 3.3.7 Calculate pH of basic solutions
- 3.3.8 Determine the pH of a solution from $[H_3O^+]$ by using a log table
- 3.3.9 Distinguish between neutralization and hydrolysis
- 3.3.10 Calculate the concentration of slightly soluble salts from the Ksp (common ion effect included)

- 3.3.11 Define and illustrate ionic bonding (electrovalence)
- 3.3.12 Explain the energy change in ionic bonding
- 3.3.13 Explain electronegativity difference and chemical bonding
- 3.3.14 Define hybridization
- 3.4 List common elements in activity series and explain which elements replace H_2 and which do not displace H_2
- 4.1.3 Describe water as a solvent
- 4.1.4 Describe the properties of water
- 4.2.5 Describe the electrical properties of aqueous solutions
- 4.2.6 Apply formulas for determining freezing point depression and boiling point elevation as a practical consideration in using molality
- 4.3.5 Solve electrode potential problems
- 4.5 Oxidation - reduction reactions
 - 4.5.1 Understand the fundamental concepts related to oxidation - reduction reactions
 - 4.5.2 Develop the fundamental skills necessary to manipulate oxidation - reduction reactions
- 4.6 The metals
 - 4.6.1 Understand the fundamental concepts related to the elements classified as metals
 - 4.6.2 Develop the fundamental skills necessary to manipulate reactions involving the chemistry of metals
- 4.7 Colloids
 - 4.7.1 Describe differences in colloids, true solution, and suspension and reasons for differences
 - 4.7.2 List common colloidal dispersions and the type dispersion represented
 - 4.7.3 List common methods of destroying colloid dispersion that cause pollution problems
- 5.3.11 Name organic compounds from their structural formula
- 5.3.12 Describe the basic nomenclature of the five basic hydrocarbon series
- 5.3.13 Explain hydrogenation of oils
- 5.3.14 Describe some differences among isomers, polymers, and monomers
- 5.4.10 Prepare a .1 N solution of NaOH, titrate against acetic acid in vinegar and determine per cent acetic acid in vinegar
- 5.4.11 Compare chemical properties of organic compounds with inorganic compounds
- 5.5 Discuss the IUC system of nomenclature
- 6.2.1.1 Work problems dealing with the half-life of radioactive elements
- 6.2.1.2 Identify transmutation products formed by alpha and beta decay of radioactive elements
- 7.0 Molecular architecture
 - 7.1 Demonstrate with models the geometry of molecules of second and third row elements
 - 7.2 Show how molecular shape and electric dipoles determine properties of matter such as solubility
 - 7.3 Relate geometry to atomic structure based on electron configurations
- 8.0 Qualitative analysis
 - 8.1 Identify metals in unknown solutions, compounds, or mixtures
 - 8.2 Identify nonmetals in unknown solutions, compounds, or mixtures
- 9.0 Industrial chemistry
 - 9.1 Discuss various metallurgical operations
 - 9.2 Explain the removal of metals from ores (Example: Fe, Al, Cu, etc.)

PHYSICS

- 1.1.5 Metric system
 - 1.1.5.1 Explain the history and simplicity of the system
 - 1.1.5.2 Name the basic prefixes of the system and give the value for each
 - 1.1.5.3 Show the relations between the metric and English systems
- 2.2.8 Derive basic equation $S = 1/2 at^2 + v_0t + s_0$
- 2.2.9 Solve for distance, time, velocity, and acceleration using the series of equations for freely falling bodies
- 2.4.5.1 Determine the mass of one object if the mass of the other object, the distance, and gravity are known
- 2.4.7 Calculate mass of another planet in relation to mass of earth, using known facts of planet's orbit
- 2.5.6 Show that the basic equation $\theta = 1/2 at^2 + \omega_0t + \theta_0$ is of the same form as that for rectilinear motion
- 2.5.7 Distinguish between rotary and curvilinear motion
- 2.5.8 Define angular velocity and acceleration and moment of inertia and solve problems in these areas
- 2.5.9 Explain the concept of conservation of angular momentum and solve problems in this area
- 2.8.9 Derive Bernoulli's equation and qualitatively apply it to aircraft control surfaces
- 2.8.10 Discuss real fluid effects (boundary-layer)

- 2.9 Simple harmonic motion
 - 2.9.1 Define the terms periodic motion and simple harmonic motion
 - 2.9.2 Explain the relationship between circular motion and simple harmonic motion
 - 2.9.3 Discuss the pendulum
 - 2.9.4 Determine the period of a pendulum using the equations of simple harmonic motion
- 3.24 Discuss Joule's experiment on the mechanical equivalent of heat
- 4.2.1.1 Define sound--physically and physiologically
- 4.2.13 Discuss subsonic and supersonic flow (shock waves)
- 5.3.9 Discuss the critical angle of refraction and total reflection
- 6.2.11 Discuss the effect of internal resistance of a generator
- 6.2.12 Discuss resistances and emfs in series and parallel circuits
- 6.2.13 Discuss and apply Kirchoff's rules relative to networks
- 6.2.14 Correlate the laws of Ohm and Kirchoff and show where Ohm's deviates and Kirchoff's upholds
- 6.2.15 Discuss the sources of electrical current
- 6.3.4 Know how to compute an electric bill by reading a meter
- 6.3.5 Use I, R, and V to compute a theoretical electric bill
- 6.5 Electron tubes and circuits
 - 6.5.1 Discuss the vacuum tube, its construction, and how it works
 - 6.5.2 Discuss the diode and its use
 - 6.5.3 Discuss power supplies as they use diode
 - 6.5.4 Discuss the triode amplifier as a low frequency amplifier
 - 6.5.5 Discuss the triode amplifier as a high frequency amplifier
 - 6.5.6 Discuss some circuits to include those in simple radio receivers
 - 6.5.7 Discuss the transistor and how it works
- 7.4.4 Derive the newtonian and relativistic transformation equations
- 7.4.5 Incorporate a fictionalized application of relativistic effects
- 8.0 Electronics
 - 8.1 AC circuit components
 - 8.1.1 Discuss AC voltages and currents as electric waves and relate these concepts to household current and voltage
 - 8.1.2 Draw a parallel plate capacitor and discuss capacitance
 - 8.1.3 Discuss inductance and examples of inductances used in electronics
 - 8.1.4 Explain the concept of impedance as an AC analog to resistance emphasizing that capacitors and inductors have finite impedances that depend on frequency
 - 8.1.5 Identify resistance as a form of impedance that is frequency independent
 - 8.2 Electronic components
 - 8.2.1 Discuss Ohm's laws as an I-V characteristic plot indicating resistance to the slope
 - 8.2.2 Draw the I-V curve for a diode pointing out that resistance is low in the forward directions and is high in the reverse direction
 - 8.2.3 Draw the circuit symbol for a diode
 - 8.2.4 Draw the set of I-V curves for a transistor pointing out how the curves change with different control currents
 - 8.2.5 Draw the circuit symbol for a transistor and identify the emitter, collector, and base leads
 - 8.2.6 Draw a set of I-V curves for a triode vacuum tube and compare with those for a transistor
 - 8.2.7 Draw the circuit symbol for a vacuum triode and identify the cathode, plate, and grid
 - 8.2.8 Show a typical electronic circuit and point out components discussed
 - 8.3 Electronic circuits and applications
 - 8.3.1 Compare a transistor with a valve controlling a flow of current from the emitter to the collector
 - 8.3.2 Draw the circuit for a one-transistor amplifier, indicating values of components and discussing their use in the circuit
 - 8.3.3 Explain resonance of an LC circuit as a frequency selective combination which has a maximum response at a frequency $f_0 = 1/\sqrt{LC}$
 - 8.3.4 Discuss a radio in terms of LC circuits tuned to a particular frequency by means of a variable capacitor
 - 8.3.5 Discuss radio waves as electromagnetic waves and compare to light waves
 - 8.3.6 Identify the frequency ranges used in radio and TV
 - 8.3.7 Discuss amplitude modulation (AM) and frequency modulation (FM) identifying the electromagnetic radiation as being a carrier wave to which an LC circuit is tuned
 - 8.3.8 Illustrate as many wave properties as possible using an oscilloscope
 - 8.3.9 Explain the operation of the oscilloscope

9.4 Chemical Mathematics Refresher

- 9.1 Calculate logarithms as related to pH and pOH of solutions
- 9.2 Calculate antilogarithms as related to pH and pOH of solutions
- 9.3 Give examples of ratio and proportions as used in chemistry
- 9.4 Significant figures
 - 9.4.1 Show the method of determining significant figures
 - 9.4.2 Explain operations of numbers with regard to significant figures
 - 9.4.3 Explain the importance of significant figures
- 9.5 Discuss scientific notations and their operations